A Dissertation on

A STUDY ON CAUSES AND MANAGEMENT OF ENTEROCUTANEOUS FISTULA

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(BRANCH I)

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CERTIFICATE

I, hereby declare that the dissertation entitled **"A STUDY ON CAUSES AND MANAGEMENT OF ENTEROCUTANEOUS FISTULA"** is the bonafide research work done by **Dr. S. PRASHANTH** and submitted in partial fulfilment of the requirement of the degree of Master of Surgery in General Surgery, Coimbatore Medical College and Hospital, Coimbatore.

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I solemnly declare that the dissertation titled **"A STUDY ON CAUSES AND MANAGEMENT OF ENTEROCUTANEOUS FISTULA"** was done by me from July 2017 to July 2018 under the guidance and supervision of **PROFESSOR. DR. V. ELANGO M.S.**

This dissertation is submitted to the Tamilnadu Dr. M.G.R Medical University towards the partial fulfillment of the requirement for the award of M.S Degree in General Surgery (Branch I).

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DATE: **Dr. S. PRASHANTH**

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Introduction:

A fistula is an abnormal connection between two epithelialized structures. An enterocutaneous fistula is a fistulous tract between the bowel lumen and the abdominal wall causing the contents of the lumen to spill out through the tract. Enterocutaneous fistulae though rare are often associated with high morbidity and mortality. However, over the past half century, the mortality associated with gastrointestinal fistulas has decreased from 40% to 60% to approximately 15% to 20% of patients (1). This fall in the mortality and the morbidity is due to various advancements in the management of sepsis, electrolyte imbalances, acid base imbalances and nutritional supplementations (2).

Enterocutanous fistula may be primary or secondary. Primary fistulas occur as a consequence of underlying disease in the bowel like Chron's disease or malignancy. Other factors are post radiation therapy for malignancy, distal obstruction; iatrogenic or spontaneous bowel injury, complicated intra-abdominal infections such as tuberculosis, amoebiasis, and typhoid, or diverticular disease (3). Secondary fistulas occur as a consequence of injury to an otherwise normal gut during surgical or endoscopic procedures. The majority of the fistulas (75% to 85%) are of the secondary type following surgeries (4). It commonly occurs due to anastomotic leaks, intraoperative injury to the bowel or its blood supply, erosion from intra-abdominal tubes or drains, placements of prosthetic meshes

and misplacement of sutures while closing the abdominal wall. Fistulas may also develop after percutaneous drainage of abscess or a hematoma.

Management of intestinal fistulas provides a surgeon with multiple challenges. Careful attention must be paid to the physiologic, metabolic, and immunologic derangements in these patients. These fistulas are potentially life threatening to the patient because of several reasons. First, the patient is usually systemically ill with severe sepsis. Second, they are malnourished and dehydrated and present with wide varieties of electrolyte and acid and base abnormalities. The loss of nutrient rich fluid through the fistula leads to malnourishment and loss of essential micro and macro nutrients. The patients are in a hypercatabolic state due to sepsis, postoperative stress and the lack of protein intake required for normal anabolism.

Enterocutaneous fistulas still have a high unacceptable mortality rate and their management is very complex and is a big challenge to the surgeon. It results in some serious complications that lead to prolonged hospitalization and high cost of treatment. It also causes severe psychological distress to the patient due to severe pain and discomfort. Also, malodorous discharge from the fistula creates a stigma to the patients and their relatives. The most common reasons for high mortality are sepsis followed by malnutrition.

Edmunds et al identified the classic triad of complications of enterocutaneous fistulas as sepsis, malnutrition, and fluid or electrolyte abnormalities (5). Septic complications related to ECFs range from localized abscess, soft tissue infection, generalized peritonitis, or frank sepsis. Sepsis should be aggressively treated with early control of fistula, drainage of any abscesses or localized collections and appropriate antibiotic therapy.

Postoperative ileus, loss of bowel integrity and absorptive surface area, sepsis, and the external loss of protein-rich enteric contents all contribute to the malnutrition and fluid and electrolyte abnormalities commonly seen in patients with enterocutaneous fistulas. Early and aggressive correction of fluid and electrolyte abnormalities and providing adequate (parenteral or enteral) are of paramount importance in minimizing or avoiding these complications altogether.

These patients ultimately develop intestinal failure that aggravate the sepsis. This results in a vicious cycle that leads to worsening of the patient and if not intervened leads to loss of quality of the life of the patient and ultimately the death of the patient.

Proper and timely management of sepsis, preventing malnourishment and correction of electrolyte imbalances in these patients at the earliest and stabilising the patient initially is necessary so that definitive management of the fistula may be undertaken.

There are several classification systems for enterocutaneous fistulas. They may be classified based on the aetiology as primary or secondary fistulas. They may be classified depending on the output of the fistula as (6)

- Low output (< 200ml/day)
- Moderate output (200-500ml/day)
- High output (>500ml/day)

An accurate measurement of the fistula output is highly essential for the correction of dehydration and the evaluation of the chemical makeup of the fistulous output is essential for treating the electrolytes and acid base abnormalities. High output fistulas are more frequently associated with electrolyte abnormalities and dehydration than low or medium output fistulas. (6)

Enterocutaneous fistulas are also classified according to the site of the fistula they may be

- Gastro-cutaneous fistulas
- Duodenal fistulas
- Small intestinal fistulas and
- Large intestinal fistulas

They are classified as such because the management of each is highly different from each other.

Such varied forms of classification are highly essential for proper management of these fistulas. These distinctions provide important prognostic information about the physiological impact of the fistula and the likelihood of spontaneous closure or if there is need for any surgical intervention.

As already stated, secondary postsurgical enterocutaneous fistulas are common than the primary fistulas. This study focuses only on postsurgical fistulas that were diagnosed in our institution during the study period. The various factors that play the role in the formation of fistulas, the resolution of sepsis, the correction of malnutrition, normalisation of electrolyte disturbances is discussed in this study.

Also, the factors that play a role in the spontaneous closure of the fistula or the need for surgical intervention and closure of the fistula the factors that play a role in the recurrence of fistulas are discussed in this study.

Successful management of a patient with enterocutaneous fistula requires a multi-disciplinary team of health care workers, including surgeons, infectious disease specialists, intensivists, radiologists, nurses, entero-stomal therapists, and nutrition specialists. Management of these patients must also take into account

the psychosocial and emotional needs of the patient and his/ her family through a prolonged and often complex treatment course.

Background:

Enterocutaneous fistula is still a rare and dreaded complication which can virtually occur in any gastrointestinal surgery or endoscopic procedure. About 40 years ago the role of malnourishment in enterocutaneous fistula was recognised to be associated with increased morbidity and mortality. (7) this was confirmed by Chapmen et al who found out that patients who receive more than 3000kcal/day had a mortality of 12% while those who received less than 1000kcal/day had a mortality of 55%.

Since the time of introduction of parenteral nutrition in the 1970s, the mortality rate of patients with enterocutaneous fistula is grossly reduced and the incidence of spontaneous closure of fistula is also increased. The improvement of these statistics for sure is not only due to parenteral nutrition but also due to rapid improvement in intensive care; including monitoring respiratory care, newer antibiotics, and better fluid and electrolyte balance.

However, Enterocutaneous fistulas still have unacceptable mortality rate (1) and their management poses a great challenge to the treating surgeon because it results in serious complications that lead to prolonged hospitalization. In addition, it also causes severe psychological distress to the patients and their family members.

This study deals in detail the various factors; modifiable and nonmodifiable that favour or go against the betterment of the patient and ultimately the resolution of the fistula; spontaneously or surgically, the development of complications and the successful management of the complication.

Majority of the fistulas are managed conservatively by assuring adequate nutrition, reducing sepsis by using antibiotics, drainage of any abscesses or collections, exteriorisation of fistula, parenteral nutrition and correction of electrolyte and acid base disturbances. Spontaneous closure of fistula is expected and surgical intervention is done if there is no spontaneous closure.

It may be said that the critical tenets in successful management of gastrointestinal fistulas are recognition of the fistula, control of infection and further contamination, restoration of fluid and electrolyte losses, and reestablishment of a positive nutritional balance before undertaking major definitive corrective procedures.

Rationale

Enterocutaneous fistulas though a long-known entity still has a high mortality. Expectant treatment of these fistulas is associated with high mortality (8) . There is need for increase in surgical intervention and management of these fistulas is still a big challenge to the surgeon

Aims and Objectives

Though enterocutaneous fistulas are primary and secondary this study focuses only on post-surgical enterocutaneous fistula.

The aim of this study is to review various factors that are contributory in:

- Development of enterocutaneous fistulas
- The course of this disease
- Development and correction of complications and
- Successful treatment of the disease
- Increased mortality and morbidity

Materials and Methods

21 Successful patients who develop enterocutaneous fistulas following elective or emergency surgeries done in this institute during the study period and 2 patients who were referred to this institute with postsurgical enterocutaneous fistula are studied prospectively. Patients were managed in four stages according to Shackelford's guidelines (6). The patients were selected based on the following inclusion and exclusion criteria.

Inclusion criteria:

1) patients developing enterocutaneous fistulae in Postoperative period.

2) patients referred with postsurgical enterocutaneous fistula for further

Exclusion criteria:

1) patients with oesophageal, biliary, pancreatic and anal fistulae.

2) patients with primary enterocutaneous fistulae due to causes other than postsurgical.

3) pregnant patients.

4) psychiatry patients.

5) patients below 15 years of age.

Patients were initially stabilised with aggressive correction of fluid and electrolyte imbalances in the first 48 to 72 hours. Fluid input was given in accordance to their renal parameters and the fistulous output. Strict input and output charts were maintained and urine output was maintained at a minimum of 0.5 ml/kg/hr. Inotropes were used if the patients fail to respond to fluid resuscitation alone. Patients were monitored for signs of overhydration like pulmonary edema or pedal edema. Isotonic fluids like normal saline or ringer's lactate solution was used to correct fluid loss. Serum electrolytes including sodium and potassium were estimated 6^{th} hourly and corrected as and then required. Serum calcium was also estimated once daily and correction was given if necessary.

The need for transfusion was evaluated based on the hemodynamical status, haemoglobin and haematocrit of the patients of the patient. Vigorous monitoring of the patient in our surgical intensive care unit was done.

They were started on intravenous third generation cephalosporins and proton pump inhibitors and anti-emetics if needed. Analgesic usage was titrated to the patient's needs. Opioid analgesics were preferred if the initial surgery was due to perforated peptic ulcer or in the presence of renal failure. The fistulous output and blood were sent for microbiological analysis.

Leucocyte counts were done daily and antipyretics were used along with tepid sponging to bring down the temperature if the patients develop fever as

needed. Higher antibiotics were used if the sepsis persists and patient worsens. Subsequent antibiotic therapy is modified in accordance to the patients' culture and sensitivity reports

Intravenous human albumin and fresh frozen plasma were administered correct the hypoalbuminemia and patients were maintained in a positive nitrogen balance.

The fistula was classified based on the anatomy of the fistula and the output of the fistula. The fistula output was calculated either directly from drains if possible or by counting the number of pads soaked for 24 hours. The skin around the fistula is daily dressed using zinc oxide ointment to reduce excoriation and using plaster adhesives is reduced as much as possible. The choice of this method was made due to low cost as compared to costly wound collecting devices.

Inj. Octreotide 100 micrograms was given thrice daily subcutaneously for 14 daysif there is reduction in the output. If there is no reduction in the output it was stopped after 5 days.

Central venous access was obtained through the patients right internal jugular vein for purpose of administering large amounts of fluids electrolytes and total parenteral nutrition.

Nutrition support was started as soon as the patient is stabilized. Enteral nutrition was preferred if possible either through a jejunostomy tube if it was

already in place or through oral route in case of very distal fistulas. Patients were fed with a protein rich preparation and hypotonic solutions were avoided. High osmolality oral rehydration solutions were preferred when available or regular WHO's ORS was used. Whenever possible the fistula output was entirely refed into a distal feeding enterostomy tube. The daily delivered volume should include both maintenance fluids and ongoing fistulous losses.

Total parenteral nutrition was given to patients as the only form of nutrition if enteral nutrition is not possible or a supplement to enteral feeding as subjected to availability in our institution using a prepacked mixture of amino acids, dextrose and lipids. Patients were given a minimum of 3000kcal/day as recommended by Raafat et al (7). Patients were monitored for development of complications from total parenteral nutrition.

After stabilising the patient then imaging studies are done to define the anatomy of the fistula. Ultrasonogram and Computed Tomography was done to look for any localized intraperitoneal collections or abscesses and also to rule out distal obstruction. Once the fistula anatomy is defined then if required exteriorization of the fistula is done along with a distal mucous fistula or a tube enterostomy for feeding as temporary procedure any distal obstruction is removed using a proximal defunctioning stoma. Any abscess or collection in drained and thorough wash given.

Definitive procedure is done only once the patient becomes hemodynamically stable, after improving the nutrition status of the patient, resolution of sepsis and there is no sign of spontaneous closure.

During this entire period various parameters were analysed and recorded for the purpose of this study. One patient had recurrence of fistula following surgical closure of the fistula and she was managed in the same way as the first time she developed the fistula.

Review of literature

Aetiology of enterocutaneous fistulas

Enterocutaneous fistulas are classified according to the aetiology as

- Primary
- Secondary

Primary fistulas

Primary fistulas are those that arise in the presence of an underlying bowel disease. These include Chron's disease, malignancies, radiation induced enteritis, diverticular disease, pancreatitis, peptic ulceration, tuberculosis or actinomycosis (9).

The management of these fistulas are different from secondary fistulas. While the management of secondary fistulas is usually done surgically, primary fistulas are usually managed conservatively as the recurrence rate of fistulas is usually very high because of the underlying disease in the bowel. A review of literature revealed the following protocols for management.

Chron's disease

The primary pathophysiology in Chron's disease is the fissuring ulcer that penetrates the full thickness of the bowel wall, leading to abscess formation. The abscess in turn breaks through the adjacent viscous or the anterior

abdomen wall leading to formation of fistula. Incidence of fistula is around 17% to 50% of Chron's patients and about 35% of these have recurring fistulas. (10) The disease usually involves distal ileum but can also occur from Chron's colitis. Neglected disease usually spreads to adjacent bowel. Crohn disease is a rare cause of gastrocolic, duodenocolic, or duodenocutaneous fistulas. Primary gastric or duodenal involvement is reported in less than 1% of patients with Crohn disease; duodenocutaneous fistulas may develop from the first or second portion of the duodenum. However, most gastric or duodenal fistulas are internal and result from involvement of primary Crohn disease of the transverse colon or, more commonly, from recurrence at the ileocolic anastomosis after previous resection. Those with gastrocolic fistulas have a 40% incidence of vomiting, which may be feculent; duodenocolic fistulas are often asymptomatic, with only a 4% incidence of vomiting, which is not usually feculent (11). Resection is usually influenced by the extent of sepsis in these patients. Proximal ileostomy may be done to divert the fistula while anastomotic site dehiscence is pretty common.

Diverticular disease:

The most common part of bowel involved in a fistula in colonic diverticulosis is the sigmoid colon. Sigmoid colon fistulas may also communicate to the bladder (colo-vesical fistula). This is manifested clinically as pneumaturia or passage of air bubbles in urine. Surgical excision of the fistula is usually sufficient. A defunctioning colostomy may be placed to allow the colon to heal

after anastomosis. A colo-vaginal fistula may arise in female who have underwent a hysterectomy

Necrotising pancreatitis:

Necrotising pancreatitis with stricture of the proximal pancreatic duct may lead to destruction of the distal duct causing formation of fistulas with the adjacent small bowel. Fistulas may also occur due to small bowel injuries during repeated necrosectomy and use of laparostomy for access to pancreatic necrosis.

Radiation Enteritis

Radiotherapy for gynaecological, colorectal or genitourinary malignancy may lead to formation of radiation enteritis. The long-term effects of radiation on the gut is the depletion of actively dividing cells and development of obliterating vasculitis lead to erosion of the bowel wall and formation of enterocutaneous fistulas. Surgical excision of the fistulas with proximal diverting stomas is the mainstay of treatment. Surgery is usually complicated with refistulisation and intra-abdominal sepsis.

Neoplasia:

Intra-abdominal malignancies may rarely present with enterocutaneous fistulas in its advanced stage. Inoperable malignancies with fistula may be

manged with a proximal stoma. However, these patients are terminally ill and may be manged conservatively.

Secondary Enterocutaneous Fistulas:

Secondary enterocutaneous fistulas are those that occur post-surgically their aetiology may be studied in more detail by classifying them based on the anatomical origin of the fistulas.

Gastric and Duodenal Fistulas

The majority of gastric and duodenal fistulas occur after surgical, endoscopic, or interventional procedures. Anastomotic or suture line failures account for 80% to 85% of all such fistulas. Postoperative leaks from gastric staple or suture lines after ulcer surgery accounted for most perforations in the past. However, the decline in gastric resection for ulcer disease, along with the broad application of new endoscopic and laparoscopic techniques for other diseases, contributes to other newer causes of perforation, albeit at a lower incidence. Comparisons of sutured versus stapled anastomoses show no obvious superiority of either. (12)

Any of the available gastric operations for morbid obesity may result in gastric staple line disruption in the early or late postoperative period. Early

anastomotic or staple line leaks in this patient population are highly morbid and often lethal. For gastric bypasses, the 10% to 30% incidence rate of internal fistula formation after simple stapling has been reduced to 3% to 6% by either gastric division after stapling or up to three applications of the stapler without division. (13).

In a series of 318 partial gastrectomies, Pickleman reported a 1.3% anastomotic leak rate, all from the gastrojejunostomy. After total gastrectomy with Roux-en-Y esophagojejunostomy, anastomotic leaks occurred in 4.8%. (14)

The risk of leakage at gastric staple lines may be increased with the use of cautery to control bleeding at the stapled edge, intersecting staple lines within an anastomosis, and the use of a thin tissue stapler on a thickened or edematous gastric wall, which may cause overcompression, tearing, and devascularization. In such tissue a handsewn closure may be preferable. The incidence of esophageal or gastric perforation during fundoplication ranges from 0.3% to 1.9%, with a large retrospective review of 2453 procedures by Perdikis et al. showing an overall incidence of 1%. (15) Laparoscopic fundoplication may also result in delayed gastric perforation along the greater curvature from inadvertent thermal or cautery injury during division of the short gastric arteries.

Laparoscopic cholecystectomy may produce duodenal injury if the duodenum and gallbladder are densely adherent to one another as a result of either direct cutting action or cautery and thermal injury. Laparoscopic cholecystectomy

may also result in colonic injury by the same mechanisms. In addition, improperly insulated instruments may cause electrical arcing to the duodenum, small bowel, or colon with resultant perforation. These injuries are usually apparent within 24 to 72 hours and fistulas are rare.

The laparoscopically placed adjustable silicone gastric band, positioned around the proximal part of the stomach for the treatment of morbid obesity, has also resulted in gastric perforation in less than 1% of patients. (16)

Duodenal stump leakage has declined because of the decreased use of antrectomy for ulcer disease (17). Duodenal stump leakage is more common after difficult gastric resections. In a high-risk patient, morbidity and mortality can be decreased and possibly prevented by placement of a duodenostomy tube along with closed suction drains external to the duodenum.

Endoscopic polypectomy or attempts at tumor removal with a snare, cautery, or endomucosal resection may cause either immediate full-thickness perforation or deep penetration with thermal injury and subsequent delayed perforation and fistula. Percutaneous endoscopic gastrostomy tube placement has also resulted in perforation, either from dislodgement of the tube before complete gastric adhesion to the abdominal wall or from trauma during placement.

Tube insertion may perforate the adjacent jejunum or transverse colon and result in a persistent gastrojejunal or gastrocolic fistula, even after the gastrostomy tube has been removed. The substitution of a larger gastrostomy tube will not control the leakage and usually results in enlargement of the opening. Persistent drainage may require either tube removal or placement of a smaller tube, along with direct or nasogastric suction until the tract contracts down around the tube. Surgical closure is required for a persistent gastrocutaneous fistula that does not respond to such measures.

Small intestinal fistulas:

Small intestinal fistulas can arise in a number of ways. The small intestine's length, as well as its elaborate anatomy, predisposes it to association in a variety of diseases. Any surgical procedure involving the abdomen can result in iatrogenic injury to the small intestine and later fistula formation. ECFs most commonly follow postoperative complications and are often the result of technical errors at the time of an abdominal procedure.

The ileum is the most common site of origin of an Enterocutaneous fistula (1).

Webster and Carey proposed five general mechanisms for small intestinal fistula formation (18)

1.Congenital. A rare form of congenital small bowel fistula involves failure of the vitello-intestinal duct to obliterate, resulting in an ECF to the umbilicus. The diagnosis should be suggested by the appearance of faecal material at the umbilicus after postnatal slough of the umbilical cord.

2.Trauma. Traumatic injury to the small intestine that results in fistula formation usually occurs from an internal source, such as a swallowed fish bone, toothpick, magnet, or metallic object. Erosion of these objects into an adjacent loop of small intestine results in an internal entero-enteric fistula. Major penetrating trauma without damage-control laparotomy rarely results in fistula formation because these cases are explored surgically and the intestinal injuries repaired. Patients treated with damage-control laparotomy techniques have an increased risk for delayed formation of intestinal fistulas caused by prolonged exposure and desiccation of multiple intestinal loops. (19)

3.Infection. An abscess or invasive intestinal infection may erode through the intestine and create a fistula. Amebiasis, tuberculosis, coccidioidomycosis, actinomycosis, and salmonellosis may cause intestinal fistulas. Intestinal perforation at the ileum from tuberculosis and typhoid fever is still occasionally seen in the Third World. *Actinomyces* is a rare cause of after appendectomy.

4. **Perforation or Injury with Abscess**. Perforation of the intestinal wall by tumor, inflammation, or operative injury may result in the local formation of an abscess. A fistula may develop if this abscess subsequently erodes into an adjacent structure. Most ECFs develop as a result of injury to the small intestine during surgery. In addition, ECFs are caused by leakage from an intestinal anastomosis or enterotomy closure. Fistulas may also develop as a result of percutaneous drainage of an intraabdominal abscess. Abdominal wall dehiscence with evisceration and strangulation of a hernia with infarction and perforation have been implicated in the development of external fistulas.

5.Inflammation, Irradiation, or Tumor. The small intestine and an adjacent structure can become densely adherent from chronic inflammatory conditions, abdominal radiation injury, or tumor erosion. Subsequent degeneration of the common wall results in fistula formation. Inflammatory bowel disease, particularly Crohn disease, is well known to create fistulas in this fashion. Postoperative fistulas in the setting of Crohn disease are as likely to develop after simple exploration, bypass, or appendectomy as after primary resection. Fistula formation after laparotomy is usually an early complication, especially when arising from an anastomosis, whereas a late fistula generally indicates recurrent Crohn disease. Laparoscopy has been found to decrease the incidence of fistula in Crohn disease. (20)

Appendiceal Fistulas.

Fistulas of appendiceal origin may result from drainage of an appendiceal abscess or post-appendectomy in a patient either without or with Crohn's disease. In the latter case, the fistula often originates from the terminal ileum, not the cecum. The inflamed ileum adheres to the abdominal wall closure and subsequently results in fistula formation.

Colonic Fistulas.

While spontaneous fistulas of the colon may result from inflammatory conditions such as diverticulitis, appendicitis and IBD, or from advanced malignancy, the majority of colocutaneous fistulas are postsurgical, usually secondary to anastomotic breakdown following colonic resection for one of these conditions. Preoperative radiation therapy reduces the risk of local recurrence and death from advanced rectal cancer and is an accepted practice. However, radiation therapy contributes to both spontaneous and postoperative colocutaneous fistulas. Russell and Welch authors reported a 31% incidence of breakdown of primary anastomoses performed in irradiated tissues with resulting sepsis or fistula formation. (21)

Classification of Enterocutaneous Fistulas

Traditionally, fistulas have been classified into

- High output (>500 mL/d),
- Moderate output (200–500 mL/d), and
- Low output (<200 mL/d) groups.

Enterocutaneous fistulas cause the loss of fluid, minerals, trace elements, and protein, and, when improperly managed, they can result in profound irritation of the skin and subcutaneous tissues. Depending on the origin of the fistula and its anatomy, the amount of output and nature of the effluent may be estimated. However, direct measurement of these parameters for an individual fistula allows for accurate replacement and an understanding of the physiologic and metabolic challenges to the patient.

Classification of enterocutaneous fistulas by the volume of daily output provides information regarding mortality and has been used to predict spontaneous closure and patient outcome (5) (22). In the study by Edmunds et al patients with high-output fistulas had a mortality rate of 54%, compared to a 16% mortality rate in the low-output group. A multivariate analysis by Campos et al suggested that patients with low-output fistulas were three times more likely to achieve closure without operative intervention as compared to high output fistulas.

Complications

Enterocutaneous fistulas are riddled with complications and pose a great challenge to the treating surgeon. The initial complications include fluid and electrolyte abnormalities and sepsis. Then the patient develops malnutrition. These triad of complications are invariably present in all enterocutaneous fistulas and must be aggressively tackled early on the course of management. Later on, the patient develops abdominal wall and wound complications and other complications like haemorrhage, and finally intestinal failure.

Fluid and electrolyte abnormalities

Fluid and electrolyte disturbances occur commonly in patients with ECFs. The salivary glands, stomach, duodenum, pancreas, liver, and small intestine secrete 8 to 10 L/day of a fluid rich in sodium, potassium, chloride, and bicarbonate. The degree of volume loss and electrolyte imbalance depends on the anatomic location of the fistula and may exceed 3000 mL/day. (12) Duodenal fistulas are particularly prone to volume and electrolyte loss. High-output duodenal or jejunal fistulas continue to carry a mortality rate of approximately 35%. (12) A distal fistula, such as one arising from the terminal ileum, is associated with smaller fluid losses because of proximal absorption.

The most common abnormalities seen are hypovolemia, hypokalemia, and metabolic acidosis. Hypokalemia occurs primarily from potassium loss in the fistula effluent; hypovolemia contributes by causing renal retention of sodium in exchange for potassium secretion. Sepsis contributes to the hypovolemic state by raising the metabolic rate and increasing insensible water loss. Metabolic acidosis results from the loss of pancreatic juice rich in bicarbonate and is more common with proximal fistulas. Gastric fistulas may cause a hypokalemic, hypochloremic metabolic alkalosis secondary to the loss of a large volume of hydrochloric acid.

Patients with fistulas causing fluid and electrolyte abnormalities have a higher mortality rate. Advances in critical care, invasive monitoring, and aggressive fluid and electrolyte management can reduce this early mortality considerably, as evidenced by data from the Massachusetts General Hospital. (23)

Sepsis

With advances in fluid and electrolyte replacement and nutritional support, sepsis is currently the major determinant of mortality in fistula patients. Abscesses can cause and complicate fistulas. Abdominal sepsis may lead to bacteremia, local and distant infection, and multisystem organ failure. Local extension often results in wound infection and abdominal wall defects predispose the patient to additional sepsis episodes and a high mortality rate. a large series by Schein and Decker, the fistula mortality rate associated with sepsis doubled to 60% when a large abdominal wall defect was present. (24)

Abdominal wall complications

Skin erosion and excoriation commonly result from an ECF. The digestive effects of the gastrointestinal secretions, particularly pancreatic enzymes, result in considerable patient discomfort. The magnitude of the local skin excoriation depends on the output and contents of the effluent and is most severe with proximal intestinal fistulas. Malnutrition aggravates this process by delaying the formation of granulation tissue and scar. Those fistulas that occur in large open abdominal wall defects are particularly difficult to control because the effluent soils the entire gut surface. Several newer techniques for isolation of the fistulas from the surrounding wound and abdominal wall like use of ostomy appliances, wound managers, VAC dressings may be used to reduce skin excoriation. An excoriated skin may not be suitable for closure when undertaking a definitive procedure.

Other complications:

Other complications of small intestinal fistulas occur less frequently. Gastrointestinal haemorrhage can result from the formation of a fistula between the small intestine and a blood vessel. More commonly, anaemia develops chronically and is associated with slow blood loss from a friable fistula tract. Colonization and small intestine overgrowth by colonic bacteria can occur with enterocolic fistulas and result in malabsorption and severe, malodorous diarrhoea. Distal obstruction beyond the fistula tract from adhesions or other disease can

develop and result in an increase in fistula output or failure of the proximal tract to close. Finally, carcinoma has been reported in chronic fistulas, especially those associated with Crohn disease.

Predicting Closure of Enterocutaneous Fistulas

Spontaneous closure of enterocutaneous fistulas without the need for major surgical intervention is clearly a desirable outcome for these patients. The precise probability of spontaneous closure is somewhat difficult to assess since the large series reporting management of fistulas are usually derived from specialty centers for fistula management and thus not only represent a biased sample but also reflect differences in referral practice. Thus, spontaneous closure has been reported to occur in 10–75% of patients. Nevertheless, a number of factors have been suggested to be predictive of failure of spontaneous closure of fistulas. Some of these factors are modifiable, for example nutritional status, presence of local infection, and foreign bodies, while many do not include location, presence of an open wound, and the presence of distal obstruction. Knowledge of these factors should prove to be helpful in discussion of outcome with the patient and family members, as well as with the multidisciplinary team

Factors that predict failure of Spontaneous Fistula Closure (25)

- Distal obstruction
- Local infection and abscess formation
- Foreign body
- Open abdomen
- Epithelialized tract
- Fistula characteristics:
- Multiple fistula openings
- Defect >1 cm
- Short fistula tract
- Abnormal bowel at origin of fistula (radiation, inflammatory bowel disease)
- Profound malnutrition
- High-output fistula
- Jejunal origin of fistula
- Highly irritant content of the fistulous output

Risk Factors and Prevention of Enterocutaneous Fistulas

The majority of enterocutaneous fistulas arise in the postoperative period, often related to leakage of small bowel or colonic anastomoses or enterotomy closure. A number of factors have been associated with postsurgical enteric leaks. These can be divided into patient factors such as old age, immunosuppression, malnutrition, emergency surgery, and peritoneal contamination, and surgical factors such as emergency surgery, level of anastomosis, preoperative radiation, duration of surgery, blood loss, tension on anastomosis, inadequate blood supply to anastomosis, and technical error in suturing or stapling.

Use of mechanical bowel preparation, anastomotic technique (stapled vs hand-sewn; single vs double layer), and omentoplasty has not been shown to influence anastomotic integrity.

A recent meta-analysis in 2008 of 13 trials and 4601 patients showed no inference in the anastomotic leak rate when a mechanical bowel preparation was used compared to when it was not used in elective colon resection. (26)

Clearly, optimization of modifiable factors will serve to reduce anastomotic leak. In the elective setting, operations may be delayed to allow for normalization of nutritional parameters, thus optimizing wound healing and immune function. In emergency operations, the luxury of optimizing nutritional status preoperatively is not possible. Instead, emphasis should be on adequate

resuscitation and restoration of circulating volume, normalization of hemodynamics, and use of appropriate antibiotic therapy.

Once a patient has been optimized preoperatively, attention is then turned to operative techniques to minimize the development of a fistula. Performance of anastomoses in healthy, well-perfused bowel without tension provides the best chance for healing. Careful hemostasis to avoid postoperative hematoma formation will decrease the risk of abscess, while inadvertent enterotomies and serosal injuries should be identified and repaired.

A recent meta-analysis based on three randomized trials showed that omentoplasty to buttress a colonic anastomosis did not reduce the rate of postoperative radiological leaks, alter mortality or change the need for reoperation. (27) However, while omentoplasty per se does not reduce the probability of anastomotic leakage, interposition of an omental flap to separate the anastomosis from the abdominal incision may lessen the probability of injuring the bowel during closure or of an enterocutaneous fistula should anastomotic leakage occur.

Proximal diverting colostomy or ileostomy may allow sufficient anastomotic healing prior to suture-line challenge by luminal contents. A recent study pooling the data from five European randomized clinical trials studying rectal cancer care demonstrated that diverting stomas reduced the rate of

symptomatic anastomotic leaks and improved overall survival but had no effect on cancer-specific survival. (28)

Management

Management of a gastrointestinal fistula is a difficult and complex process. However, a systematic approach can lead to treatment that is effective and potentially rewarding. In general, management can be compartmentalized into five stages: (29).

1. Stabilization,
2. Investigation,
3. Decision,
4. Definitive Therapy, and
5. Healing

Management can be seen as a series of steps to control life-threatening abnormalities rapidly and then to intervene in a timely and controlled manner with convalescent or surgical care.

One should not undervalue the impact of a fistula on mental and emotional health. A gastrointestinal fistula puts a great deal of stress on a patient's self-esteem. Therefore, family members, social workers, and mental health professionals play salient roles during the prolonged convalescence that is typical with this disease process.

Stabilization

The first step in the management of an intestinal fistula is stabilization of the patient within the first 24 to 48 hours. These patients are often in a vulnerable state of health. They may be febrile and septic from a presumed wound infection treated by opening the wound. Patients require correction of obligate third-space losses, as well as emesis, fistula output, and urine output. Initial efforts should be directed toward intravenous fluid resuscitation, control of infection, ongoing measurement of fistula and urine output, and protection of the surrounding skin. The incision should be examined for fascial integrity, and any subcutaneous collections should be drained. Only after these steps are addressed should attention be shifted to identification of the fistulous source, the nature of the tract, and associated fluid collections or abscesses.

Resuscitation

Restoration of a normal circulating blood volume and correction of electrolyte and acid-base imbalances are a priority. Rehydration usually requires isotonic fluid until the patient is euvolemic. Restoration of a normal circulating blood volume and correction of electrolyte and acid-base imbalances are a priority. Rehydration usually requires isotonic fluid until the patient is euvolemic.

Initial management should address any existing hypovolemia, anemia, hypoalbuminemia; electrolyte depletion; bile salt losses; and acid-base disorders.

Strict intake and output measurements, central venous pressure monitoring, and urinary catheterization are especially helpful with high-output fistulas. The patient's urine output should be restored to greater than 0.5 mL/kg per hour, assuming that renal function is normal. In patients with cardiovascular impairment or evidence of shock, a pulmonary artery catheter may guide ongoing fluid repletion. Because the deficit in circulating blood volume is caused by extracellular fluid losses, replacement should be in the form of an isotonic solution. Normal saline or lactated Ringer solution is preferred. However, specific parenteral fluids may be selected on the basis of the initial electrolyte levels. Transfusion may be necessary. There is no specific hemoglobin or hematocrit level that requires transfusion; rather, transfusion should be based on the patient's overall hemodynamic status, oxygen-carrying capacity, and oxygen delivery.

Potassium, calcium, phosphorus, and magnesium deficits should be corrected. These electrolyte deficits take time to correct because the measured serum levels incompletely reflect the massive depletion of intracellular ions. Sodium bicarbonate administration may be required to correct the metabolic acidosis that develops with a high-output or proximal fistula.

These patients are in a severe catabolic state and have very low protein and albumin levels. patients will have low capillary oncotic pressure, which may contribute to profound edema, especially after resuscitation has begun. Severe hypoalbuminemia will take weeks to correct. Short-term supplemental

intravenous salt-poor albumin administration will help to increase oncotic pressure and minimize edema and may improve wound healing. (30)

Nutrition

Ongoing nutritional assessment and institution of nutritional support have improved the overall outcome in patients with small intestinal fistulas. With the widespread advent of parenteral nutrition, the overall reduction in mortality to a range of 15% to 20% was achieved consistently in a variety of reports, while improving the spontaneous closure rate. However, parenteral nutrition had no impact on fistula mortality; maintenance of adequate nutrition with more conventional methods was equally effective. (12) Despite aggressive nutritional support, malnutrition continues to be a major clinical problem in 55% to 90% of patients (1). Parenteral nutrition has greatly simplified the nutritional management of patients with gastrointestinal fistulas. Even though these patients often have abdominal abscesses and bacteremia, parenteral nutrition is safe and the overall incidence of catheter-related septic complications is no greater than that in other clinical situations. (23)

Because both enteric and parenteral feeding have advantages and disadvantages, the source of nutritional supplementation should depend on the individual patient and the surgeon's preference and experience. In most cases, parenteral nutrition should be instituted as soon as possible. Thereafter, steps are taken to localize the

fistula and control infection. Normal intestinal motility and function generally return once abdominal sepsis is controlled and fluid and electrolyte imbalances are corrected. If the fistula location is such that enteric access and alimentation are possible, enteral nutrition can be instituted and parenteral nutrition phased out. By using a combination of approaches, adequate nutrition can be maintained throughout the patient's course.

Control of sepsis

Uncontrolled sepsis remains the major factor contributing to mortality in patients with small intestinal fistulas. Aggressive management of ongoing infections and careful surveillance for new septic foci are necessary for successful management. Tachycardia, persistent fever, and leucocytosis predict inadequate control of the fistula or abscess formation. Frequent physical examination and judicious use of ultrasonography and computed tomography (CT) are mandatory.

The stabilization phase often involves control of a septic source. Typically, drainage of an intraabdominal abscess is required, which is ideally accomplished in an image-guided, percutaneous fashion. In addition, fistula drainage must be controlled and the skin of the abdominal wall protected. Local control is an extremely important component of the early management of a fistula. It is important to prevent the severe local skin excoriation that develops around the site of an ECF. Precautionary steps should be instituted early because once excoriation is present, healing is difficult in the presence of ongoing drainage.

A fistula should be exteriorized on a flat portion of the abdominal wall with avoidance of bony prominences and skin folds. This permits secure application of an ostomy bag or other device to collect and monitor fluids and protect the skin. Specialized nursing assistance by an enterostomal therapist or wound care specialist is necessary in the management of these complex wounds.

One useful modification of fistula wound management was described by Suripaya and Anderson. A disposable ileostomy bag with adhesive backing is fitted to the fistula site. The opening in the ileostomy bag is cut to fit the fistula as exactly as possible. Two 18-French or larger catheters with multiple side perforations are tied together and passed into the fistula through the open end of the bag. All perforations are placed within the fistula below skin level. A third 18-French catheter with multiple perforations is placed in the ileostomy bag, and the open end of the bag is tied securely around all three catheters. One of the two catheters within the fistula and the catheter lying free in the bag are set for continuous suction at a minimum of 40 mm Hg of negative pressure. The adjacent catheter in the fistula serves as an air vent. When functioning, the bag is completely collapsed, and fluid leaking from the tract is immediately aspirated away. The surrounding skin can be protected with Stomahesive paste, karaya gum powder, aluminium paste, tincture of benzoin, or zinc oxide/menthol cream. (31)

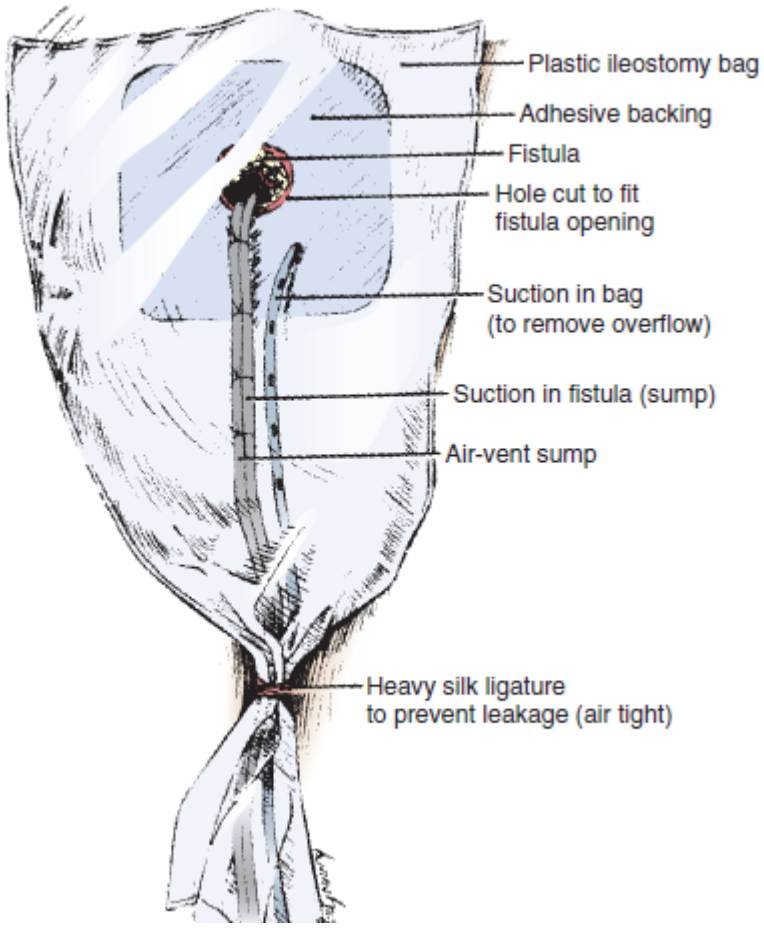

Figure 1 Enterocutaneous fistula draining device as mentioned by Suriyapa C, Anderson MC

Once intraabdominal sepsis is present, the use of antibiotics does not eliminate the need for surgical treatment or percutaneous drainage. Adequate drainage of an abscess must be accomplished. If possible, general anaesthesia and major surgical procedures should be avoided or postponed until the patient is stabilized. Ultrasound and CT are most often used to search for peritonitis or an intraabdominal abscess. These two modalities localize such processes and permit image-guided percutaneous drainage, an invaluable procedure in a critically ill patient who may not tolerate an operative procedure.

Abdominal exploration may be required in septic patients who are losing ground, even if diagnostic studies have not pinpointed an abscess. In the rare case that exploratory laparotomy is required for drainage, one should avoid the temptation of definitive repair of the fistula, as it is prone to failure. In addition, such failure may make subsequent attempts more difficult and possibly result in infection of previously uninvolved areas of the abdomen. Control of the fistula should be established during the operation by allowing complete drainage to the skin surface or by exteriorizing the fistula.

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Pharmacological Support

Octreotide

The concept of using somatostatin to inhibit pancreatic exocrine secretion in the treatment of gastrointestinal fistulas was first introduced in 1979 by Klempa et al. (32) Somatostatin, a 14-amino-acid peptide, is a well-established inhibitor of gastrointestinal secretion, inhibiting both endocrine and exocrine pancreatic secretion and reducing pancreatic blood flow.

Use of the long-acting somatostatin analogue octreotide for decreasing pancreatic and ECF output was popularized during the 1990s. An inhibitory effect on gastric, biliary, and pancreatic secretions is generally observed in clinical use. With typical subcutaneous dosages of 100 to 250 μg every 8 hours, fistulous output is reduced by 40% to 60% after the first day, regardless of fistula site or volume of output. (33)

Placebo controlled studies indicate that octreotide decreases fistula-related complications, reduces fistulous output, and decreases fistula healing time and the time required for TPN. Octreotide promotes fistula closure within a significantly shorter time than TPN alone, even with malignant enterocutaneous disease, and is particularly helpful in decreasing secretions in high-output fistulas to a manageable level (34). However, the mortality rate, hospitalization time, and overall fistula closure rate has not been improved. It has been suggested that if

fistula output is not decreased within 48 hours of treatment with somatostatin-14 or octreotide, then treatment should be discontinued. Evidence suggests that a first-day response of a greater than 50% reduction in output in response to somatostatin-14 in combination with TPN is a prognostic indicator for spontaneous closure. When used in combination, somatostatin-14 and TPN appear to exert a synergistic effect on the reduction of gastrointestinal secretions and improve fistula closure rates (35).

Proton Pump Inhibitors

Proton pump inhibitors or histamine H2-receptor antagonists are advised to reduce gastric acid production, slow transit, and reduce gastric secretions. These medications may be useful in decreasing fistula output, particularly with proximal fistulas or when gastric secretion is high.

Other Pharmacological Agents

Other agents that are helpful in reducing intestinal transit times and decreasing intestinal volume losses include anti-peristaltic agents such as

- loperamide at a dose of 8 to 16 mg/day or more,
- diphenoxylate at 10 to 20 mg/day or more,
- paregoric at 20 to 40 mL/day, or
- tincture of opium at 2.4 mL/day.

Most failures of these medications occur when suboptimal doses are used by practitioners and, in the case of patients attempting oral nutrition, when medications are timed incorrectly. It is best to administer these drugs 20 to 30 minutes before a meal.

Cyclosporin

Patients with refractory fistulas related to Crohn disease have been successfully treated with short courses of cyclosporine and other immunosuppressive drugs. In five patients with a total of 12 fistulas, Hanauer and Smith used an infusion of 4 mg/kg per day for 6 to 10 days, followed by oral dosing at 8 mg/kg per day adjusted to maintain serum cyclosporine levels of 100 to 200 ng/ mL. All fistulas responded to cyclosporine infusion with decreased drainage and improvement in both local inflammation and patient comfort. Complete resolution occurred in 10 of the 12 fistulas after a mean of 8 days. Therapy was continued for a mean of 6 months, with five recurrences, two of which were related to inadequate cyclosporine serum levels (36). Although useful for short-term treatment, long-term administration of cyclosporine is generally avoided because of the potentially septic complications of immunosuppression, as well as hypertension and nephrotoxicity.

Infliximab

Infliximab, a chimeric monoclonal antibody to tumour necrosis factor-α, was developed as treatment for Crohn disease. Infliximab is effective in closing fistulas in patients with Crohn disease. In a randomized, multicentre trial investigating infliximab administered intravenously at 0, 2, and 6 weeks and dosed at 5 mg/ kg for the treatment of 94 adult Crohn disease patients with chronic fistulas, partial resolution of multiple lesions occurred in 68% and complete closure occurred in 55% of patients (37). Complications of this therapy occur in more than 60% of patients and include headache, abscess, upper respiratory tract infection, and fatigue.

Investigation

Investigation is the next phase of management. Stabilization is accomplished in the first 24 to 48 hours; investigation usually occurs over the following 7 to 10 days. Investigation includes a thorough evaluation of the gastrointestinal tract, definition of the anatomy of the fistula, and identification of any complicating features such as abscess, stricture, or distal obstruction. Investigative studies should be designed to determine the presence and location of the fistula and to provide information regarding its cause.

Fistulogram

The most important first test is a fistulogram, A fistulogram can be performed by inserting a small catheter through the drainage site into the fistula tract and then slowly injecting water-soluble contrast under fluoroscopy. It is best performed by the responsible surgeon in collaboration with the radiologist.

Fistulography performed early in the course of the disease will help to determine

(1) the site of the fistula,

(2) intestinal continuity with the fistula,

(3) the presence or absence of distal intestinal obstruction,

(4) the nature of the intestine immediately adjacent to the fistula, and

(5) the presence or absence of an intraabdominal abscess.

Ultrasonography

These tests can define the anatomy of the vicinity of the fistula and evaluate for any ongoing or unrecognized intraabdominal processes or abscesses, as well as distal obstruction. However, the use of USG within the first week after surgery is associated with the expected presence of postoperative air within the abdominal cavity and thus may be difficult to interpret.

Computed Tomography

A CT scan will be required in almost all patients to evaluate the presence of any intraabdominal collections are abscesses. CT scanning with oral and intravenous contrast media is highly sensitive and specific for intraabdominal free air and will assist in locating the fistula and identifying adjacent fluid collections and concomitant bowel obstruction. If found, significant fluid collections should be drained and an indwelling catheter left in the cavity

.

Endoscopy

Endoscopic evaluation, including colonoscopy, esophagogastroduodenoscopy, and ERCP, may be helpful in certain specific clinical situations. However, endoscopy is not usually advisable if an acute perforation is suspected and should generally be delayed until the acute inflammatory process has resolved. Endoscopic examination of the stomach and duodenum may occasionally be used to identify a fistulous source and to take biopsy samples of adjacent tissue for exclusion of malignancy. For suspected gastrocolic or duodenocolic fistulas, colonoscopy may identify the involved site and enable a biopsy to be performed to diagnose inflammatory bowel disease or malignancy.

Diagnostic laparoscopy/laparotomy

In the rare circumstance when perforation has not been excluded by non-invasive tests and the patient's condition is not improving or is worsening, diagnostic laparotomy should be considered. Morbidity and mortality rates are only increased by a delay under these circumstances.

Diagnostic laparoscopy may be useful to rule out perforation after a previous laparoscopic procedure or after an endoscopic procedure. It is not usually appropriate in a septic, hypotensive patient and does not enable a satisfactory examination of the retroperitoneal duodenum.

Decision

The next step in fistula management is a decision on management and the timing of such management. When making these decisions, the likelihood of spontaneous closure must be estimated. The likelihood of closure depends on several factors as already discussed. Patients with poor nutritional status are much less likely to close a fistula no matter what the anatomic location. The absence of sepsis has a positive predictive value for closure.

After sepsis has been controlled and diagnostic studies have been completed, management of a fistula should follow a conservative course. An opportunity for spontaneous healing should be permitted. It is important to provide adequate nutritional support and to aggressively investigate any new

onset of signs of sepsis during this convalescent period. The duration of conservative treatment must be individualized. If a positive nitrogen balance is maintained, fistula output decreases, and no septic complications develop, nonoperative management may be continued.

The spontaneous closure rate of ECF in several large series ranged from 32% to 80%, with more than 90% of small intestinal fistulas that closed did so within a month (12). Less than 10% closed after 2 months, and none closed spontaneously after 3 months (38). Thus, a reasonable management plan may consist of at least 1 month of nonoperative management, with reasonable extensions should the fistula show signs of slow but continued healing.

Delaying operation allows peritoneal reaction and inflammation to subside, thus making a definitive surgical procedure easier and safer. Delaying repair also permits nutritional optimization, thereby decreasing the likelihood of postoperative wound complications. A postoperative ECF usually extends hospitalization by 2 to 3 months, but this period may shorten somewhat with refinements in TPN, administration of somatostatin analogue, VAC usage, and wider availability of outpatient nursing care.

The decision to operate is tempered by the patient's condition and the state of the abdomen. In particular, when faced with a firm, indurated abdomen, it is better to stabilize the infection, nutrition, and fluid balance in this circumstance,

and wait until the abdomen is soft, without significant induration, to maximize the chance for operative success and minimize the risk of creating new ECF.

One must also be aware of the quality of life, social, and psychological condition of the fistula patient. Härle et al.'s excellent study revealed that fistula patients have profound restrictions in daily life, approaches to illness, emotions, dependence, and need of support. A constant fear of leakage from the fistula appliance, being dependent on intravenous fluids and being dependent on health care professionals caused isolation and social restriction. (39)

Definitive Therapy

The next important decision is to determine whether definitive operative therapy is necessary and the timing of such therapy. When operative therapy has been chosen, the operation must be carefully planned. Whenever possible, the operation should not take place until the patient is stable, not septic, and in an adequate nutritional state. Operations repairing enterocutaneous fistulas may be complex and often lengthy. In addition to repairing the fistula, many of these patients require complex abdominal wall closures.

As for all operations, the patient should be fully apprised of the nature of the procedure and its potential for complications. Connolly and colleagues reported a very high incidence of complications (40) following intestinal reconstructive surgery (82.5% of procedures) when one considered postoperative nosocomial infections including surgical site infections, respiratory infections,

and central line sepsis together with postsurgical myocardial dysfunction, GI bleeding, and deep vein thrombosis. (40) In discussions with patients and their families, the unique difficulty of these procedures should be raised, pointing out the potential for adhesions and therefore inadvertent injury and excessive bleeding.

Reviewing the previous operative notes as well as speaking with the original surgeon will consolidate one's knowledge of the initial pathological process and the precise anatomy to be corrected in the reoperative setting.

A leaking gastroduodenostomy may be treated by distal gastric resection with conversion to a Billroth II gastrojejunostomy. Duodenal fistulas may be treated with tube duodenostomy or Roux-en-Y duodenojejunostomy. If the gastric or duodenal defect is too large to allow primary closure or the fistula originates in conjunction with the ampulla and pancreatic duct, a Roux-en-Y gastrojejunostomy is a flexible and valuable technique for dealing with such difficult gastric or duodenal fistulas. A feeding jejunostomy distal to the enteroenterostomy should be considered.

Direct suture closure of the fistula is associated with a high incidence of breakdown and fistula recurrence (24). In most cases, the preferred operation is resection of the involved segment of intestine and primary end-to-end anastomosis. In the setting of extensive sepsis, primary anastomosis may not be

appropriate. In these circumstances, exteriorization of both the proximal and distal ends of the intestine may be performed.

If the fistula is not deemed appropriate for resection, such as when it develops as a complication of a deep pelvic procedure, staged approaches involving bypass should be considered. In a staged procedure, the fistulous segment is left in situ, or the ends are exteriorized as mucous fistulas; the afferent and efferent bowel loops are anastomosed to restore intestinal continuity. Alternatively, if the efferent loop cannot be mobilized, the intestine proximal to a distal ileal fistula can be divided and anastomosed to the transverse colon. The fistulous segment is again returned to the pelvis or exteriorized as a mucous fistula. This technique is not as satisfactory as complete exclusion but works reasonably well if the ileocecal valve is competent. Optimally, the staged procedure is completed when the fistula segment is removed at a later date, although this is not always possible.

When planning the operation for fistula patients, the surgeon should allow adequate time for a difficult and prolonged procedure. Fistulas require complete resection back to healthy tissue with enteroenterostomy. If the anastomosis is performed on healthy bowel, the choice between a stapled or handsewn anastomosis does not matter. More importantly, the anastomosis should be under no tension, there must be adequate blood supply, and distal obstruction cannot be present. A feeding jejunostomy or nasoenteric tube should be placed.

Depending on the complexity of the abdominal wound, component release and other reconstructive manoeuvres may be required to achieve closure of the abdominal wall. It is frequently helpful to enlist the expertise of a plastic surgeon for closure of the abdominal wound.

As the cumulative experience with complex laparoscopic procedures has increased, several groups have reported laparoscopic approaches to enteric and enterocutaneous fistulas. The largest of these series reported (41) 73 procedures in 72 patients, 20% of which were enterocutaneous Fistulas. The authors reported a mean operative time of 199 minutes with a 4.1% conversion rate (41). Because surgical procedures for the management of enteric fistulas are generally complex ones, a laparoscopic approach would seem appropriate only in the hands of a skilled and experienced laparoscopic surgeon and only in selected circumstances.

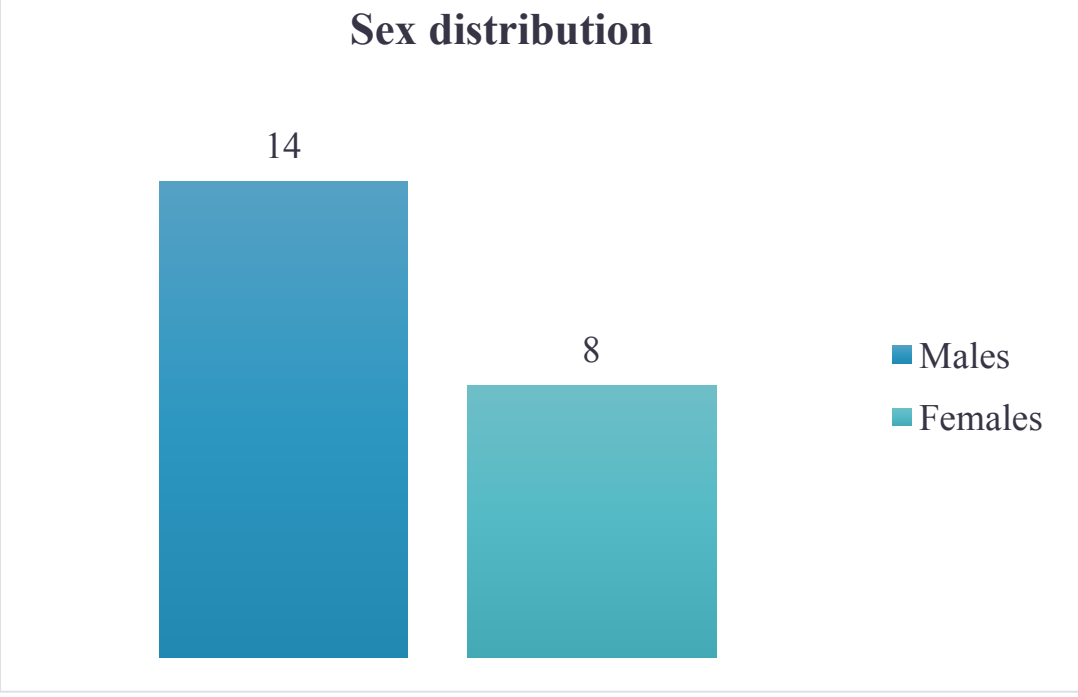
Healing

This is the final phase of treatment Optimal nutrition is as important postoperatively as preoperatively. Supplemental nutrition via enteral, parenteral, or a combination is frequently required, and with time, the patient can be transitioned to complete intake by mouth. Even when a patient cannot tolerate full caloric intake via the enteral route, providing a portion of the nutrition enterally remains an important objective. If the patient cannot tolerate at least 1500 kcal/day enterally, parenteral nutrition should be continued until this goal is achieved.

Delayed complications may include short bowel syndrome, depending on the extent of the intestinal resection, previous resections, and the underlying disease state (i.e., Crohn disease). In patients with a marginal amount of bowel remaining, some intestinal adaptation may occur, and with time, it may be possible to wean the patient off parenteral nutrition. As a general guide, approximately 90 cm of small intestine with an intact ileocecal valve may be adequate to prevent short bowel syndrome, whereas 150 cm may be necessary when the ileocecal valve has been resected. The surgeon must be vigilant for recurrent fistulas postoperatively. These patients are also highly susceptible to adhesive small bowel obstruction. It is generally prudent to manage early postoperative small bowel obstruction in these patients with long-tube decompression and TPN, rather than risk further complications with another operation in the early postoperative period.

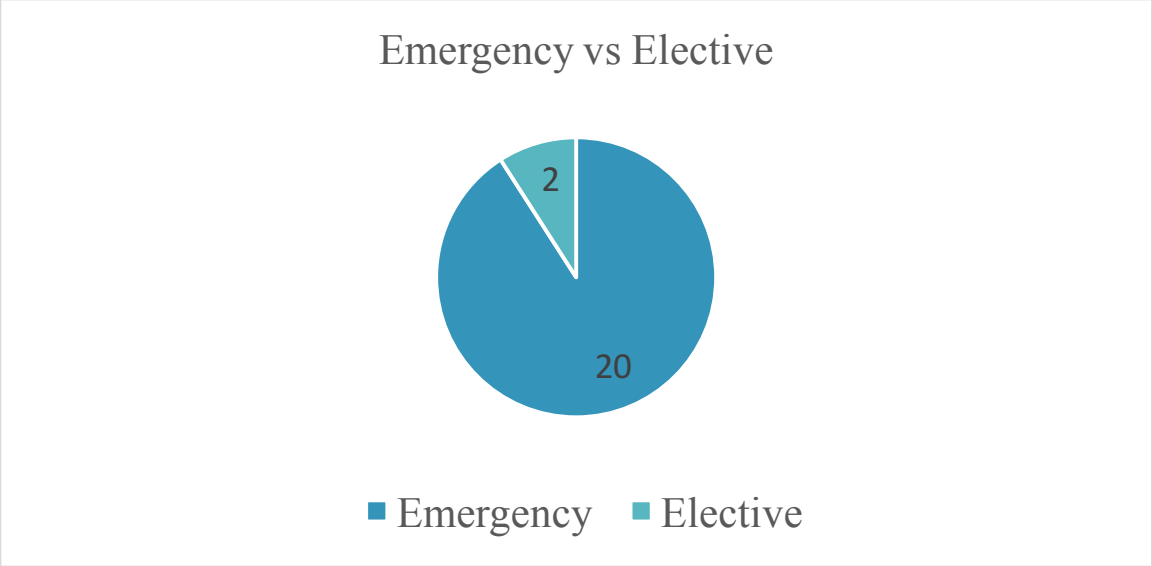
Results

Total number of patients included in this study is 22. Of these 14 were males and 8 were females. Ages were from 35 to 72 years with a mean of 55 years with a standard deviation of 10 years. The mean age of males was 56 while females was 54.

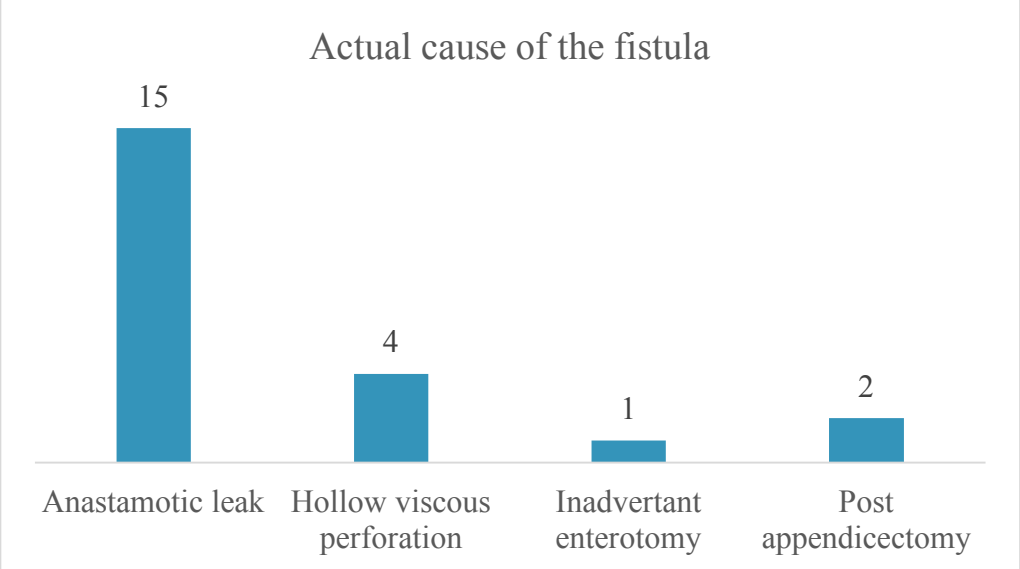


Of the 22 patients with postoperative enterocutaneous fistula, 19 were operated at this institute while 3 were referred from outside hospitals.

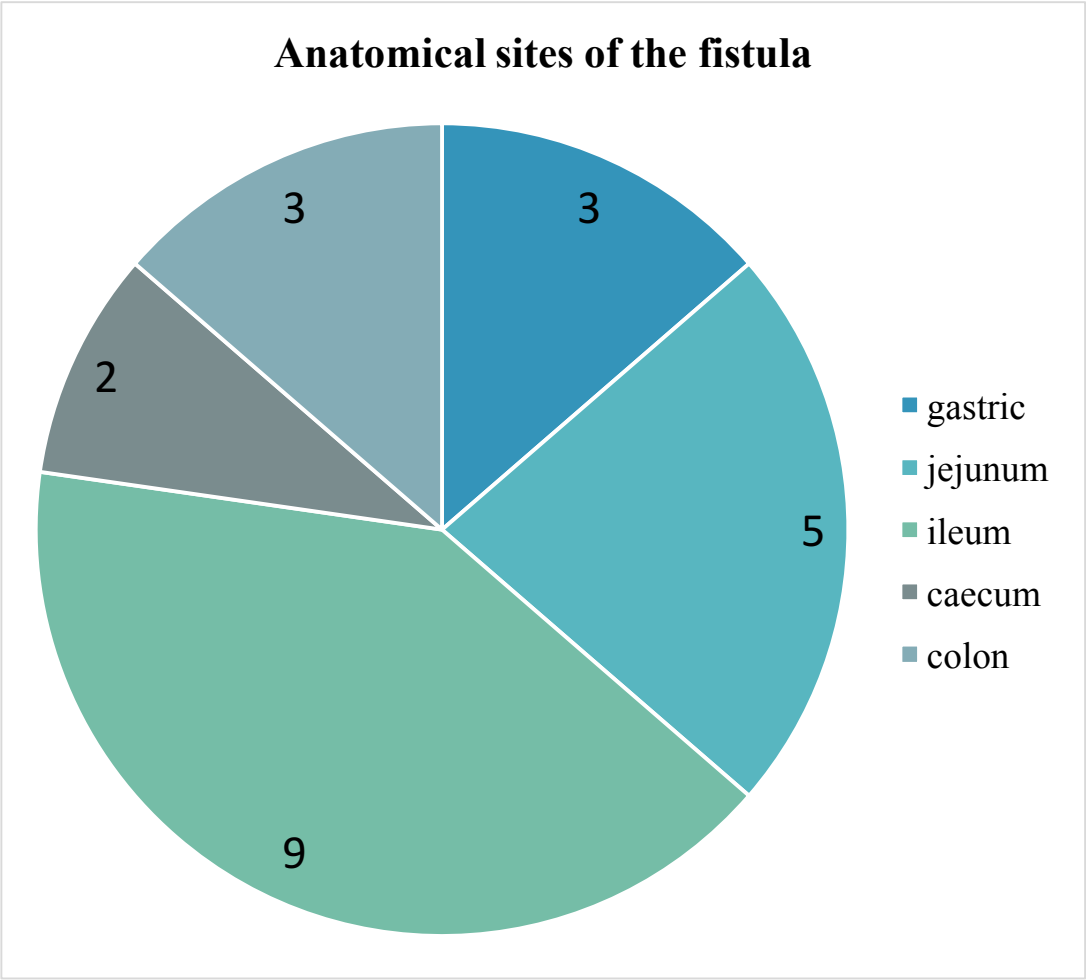
In 20 of these patients the initial surgery was an emergency procedure whereas in 2 patients the procedure was elective.



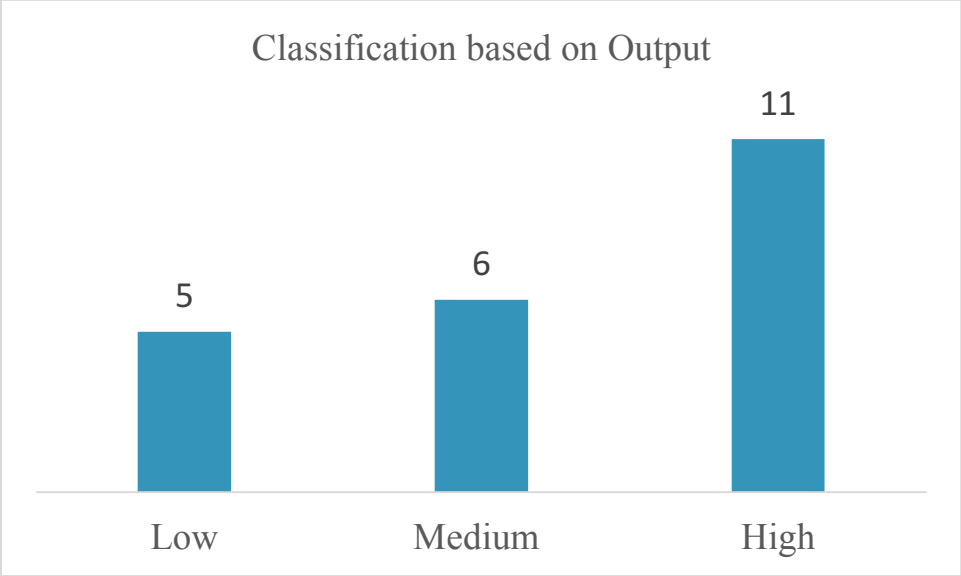
Actual causes of the fistula are as described below

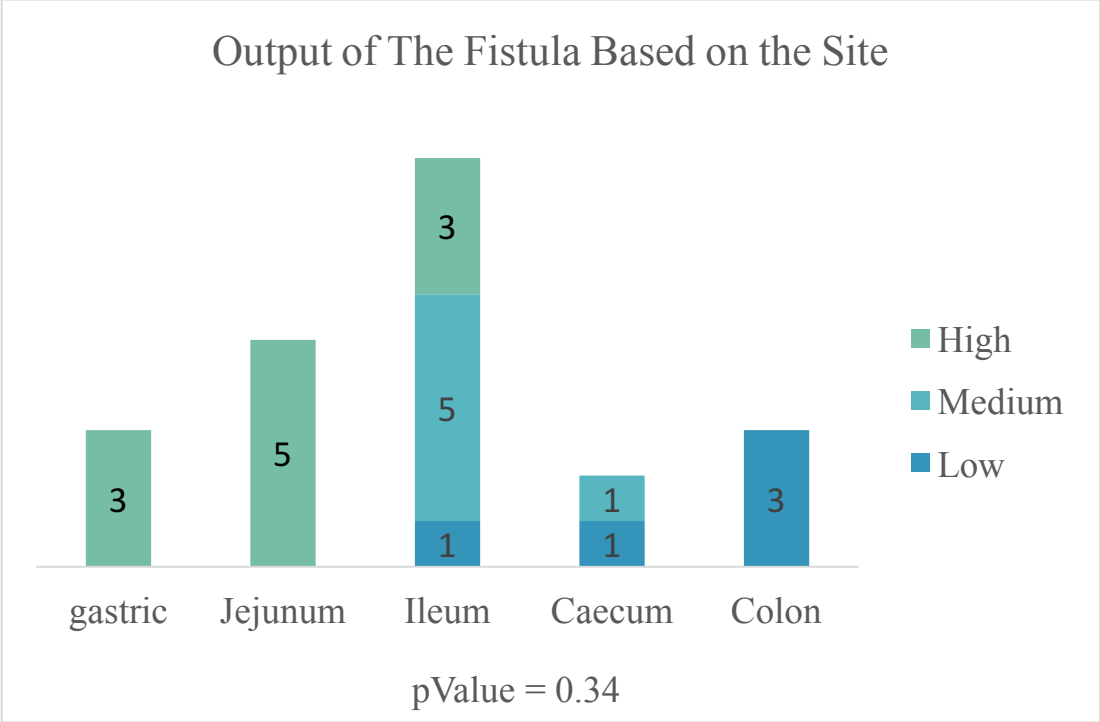


Classifying on the basis of anatomical location of the fistula they were 3 gastric fistulas, 5 jejunal fistulas, 9 ileal fistulas, 2 caecal fistulas and 3 colonic fistulas. Small intestine fistulas were more common than large intestinal and gastric fistulas.



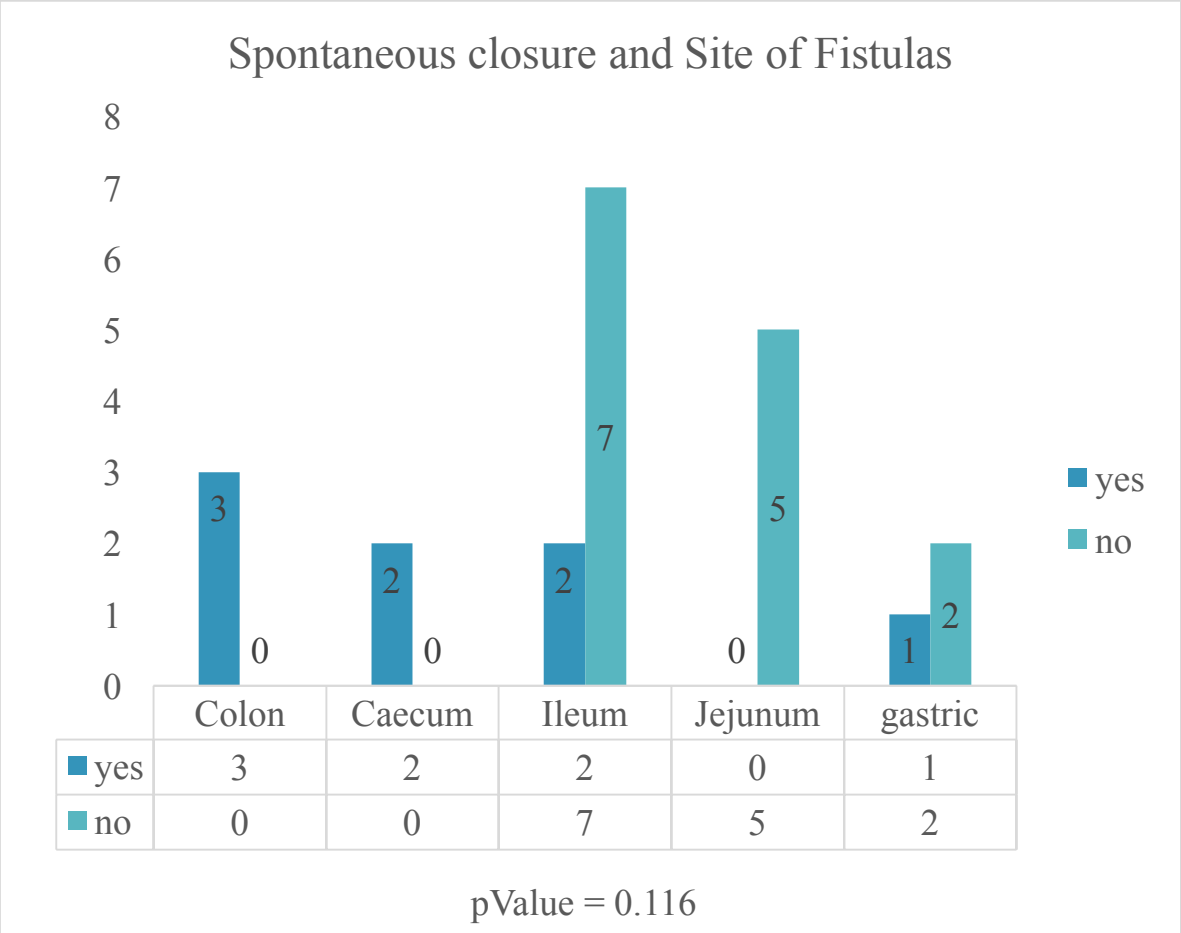
Classifying fistulas according to the quantity of output we have 5 low output fistulas (<200ml), 6 Medium output fistulas (200 to 500ml) and 11 high output fistulas (>500ml).



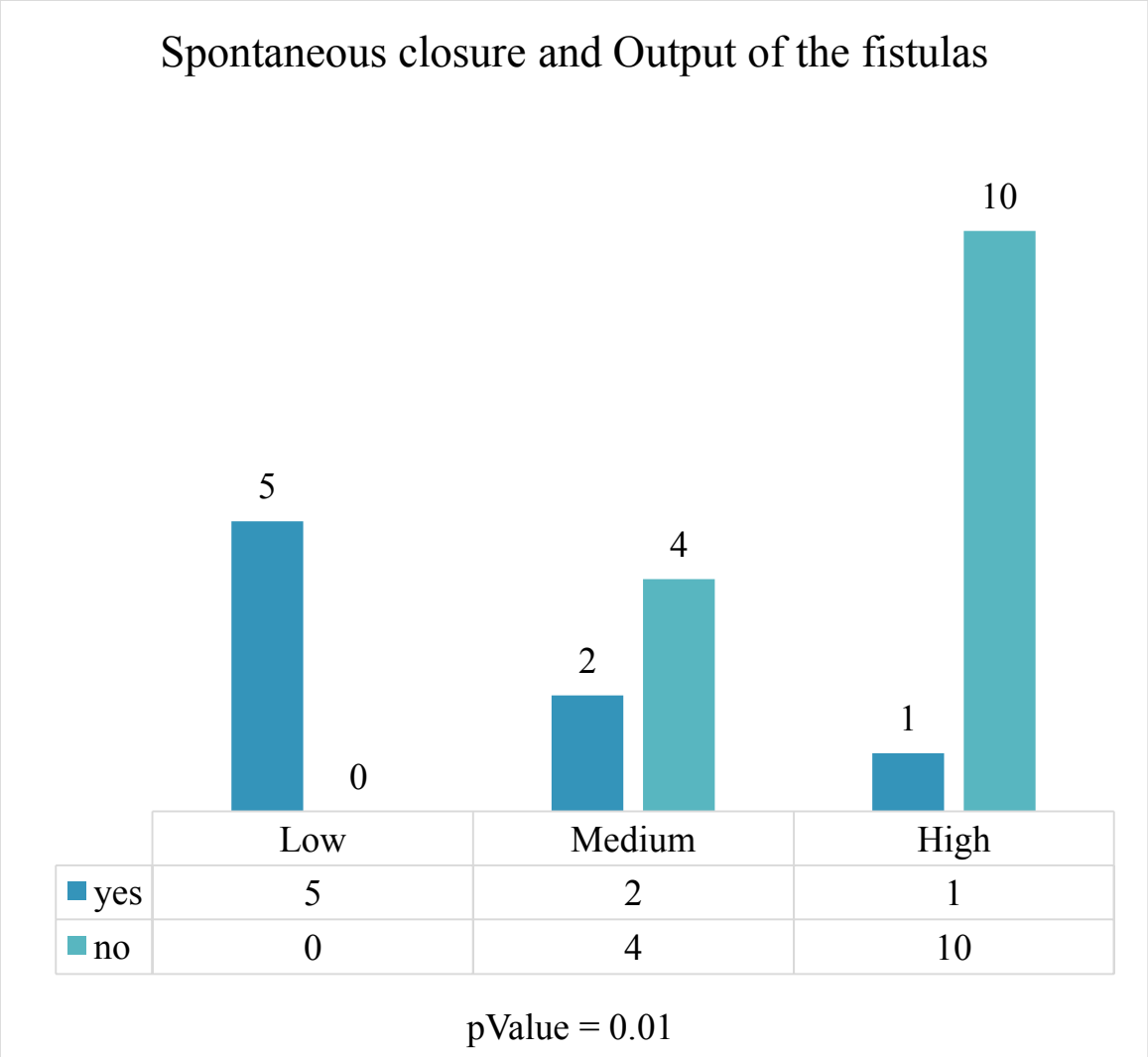


Of these gastric and jejunal fistulas were all high output fistulas and colonic fistulas were always low output fistulas. Ileum had 1 low output, 5 medium output and 3 high output fistulas and caecum had one low output and one medium output fistulas.

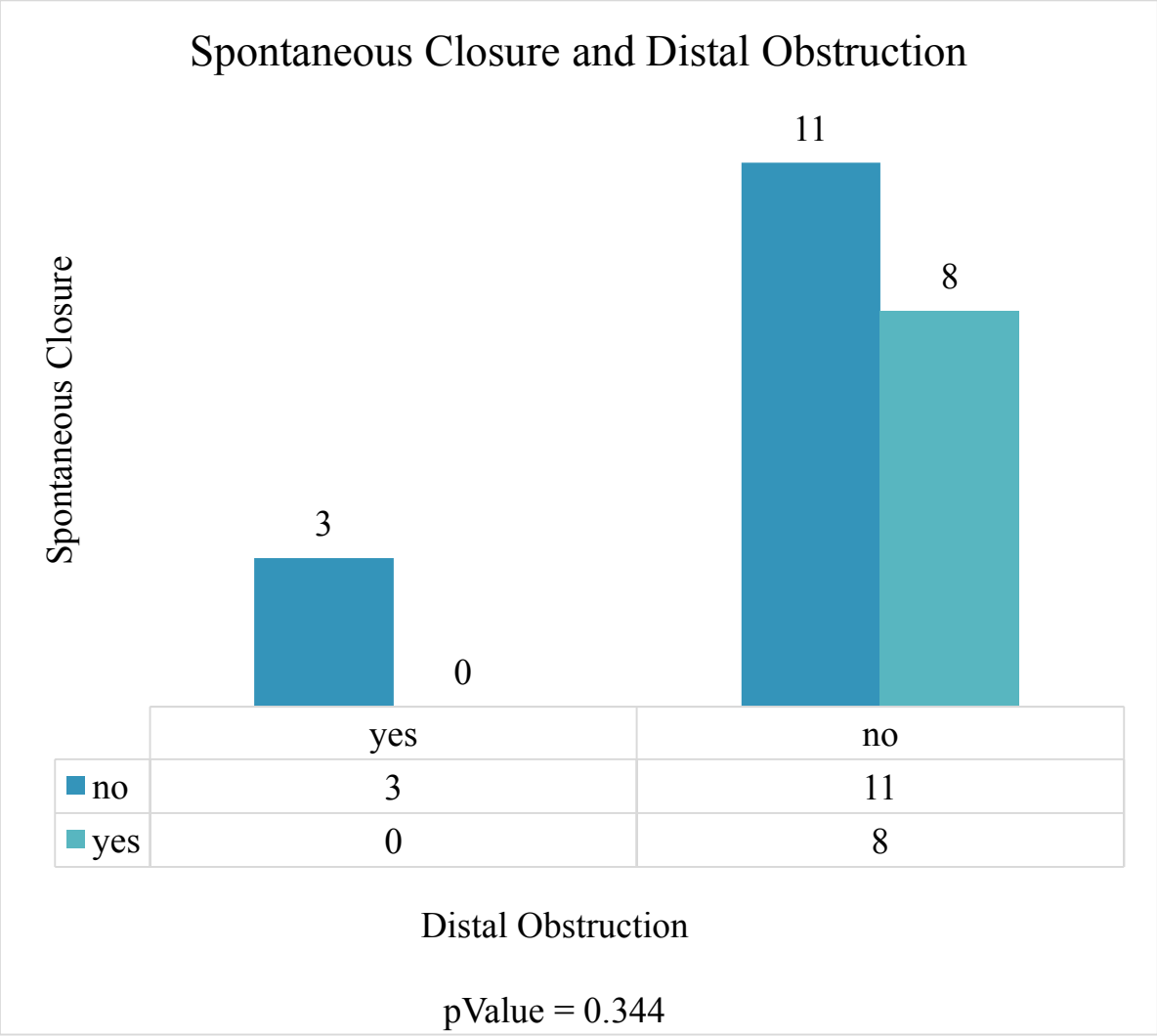
In this study 8 (36.36%) cases underwent spontaneous closure and 8 cases (36. 36%) underwent surgical closure. The remaining 6 patients (22.22%) succumbed to the disease at some point. Of the gastric fistulas, 1 (33.33%) closed spontaneously while of the 9 ileal fistulas 2 (28.57%) closed spontaneously. None of the jejunal fistulas closed spontaneously while all of the caecal and colonic fistulas closed spontaneously. The p value is 0.11.



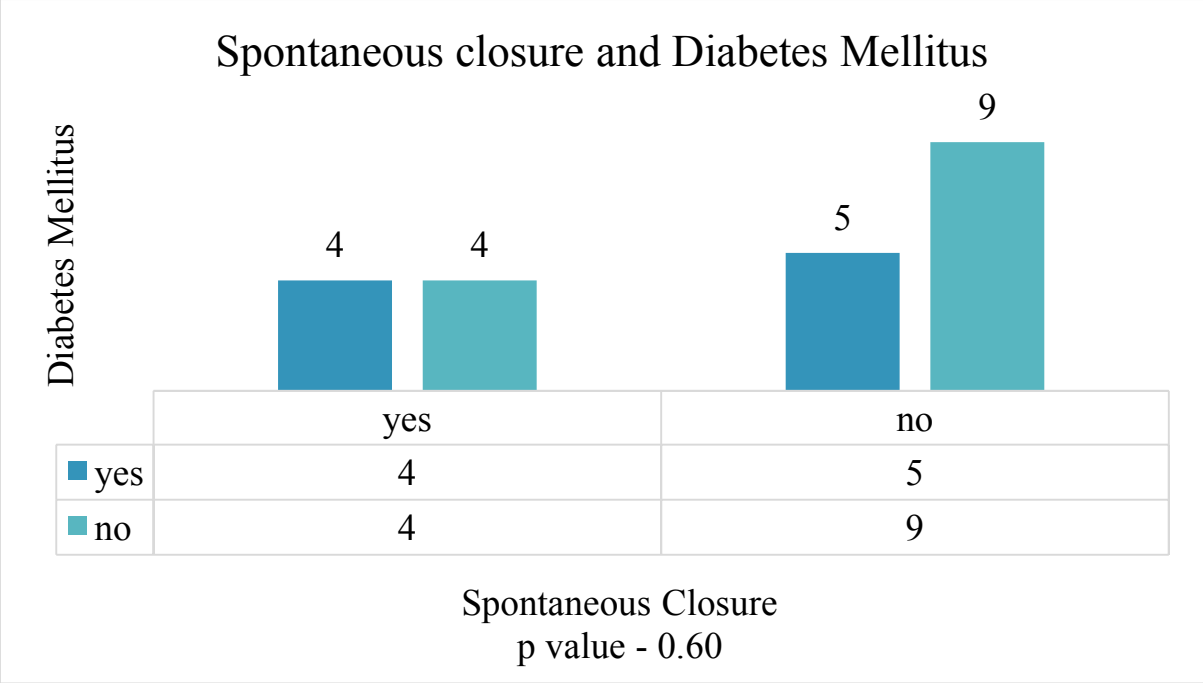
Comparing the output of the fistulas and the spontaneous closure rates we can see that all of the 5 (100%) low output fistulas had spontaneous closure whereas 2 (33.33%) of the medium output fistulas underwent spontaneous closure and only 1 (9%) of the high output fistulas underwent spontaneous closure. The p value is statistically significant. (0.01)



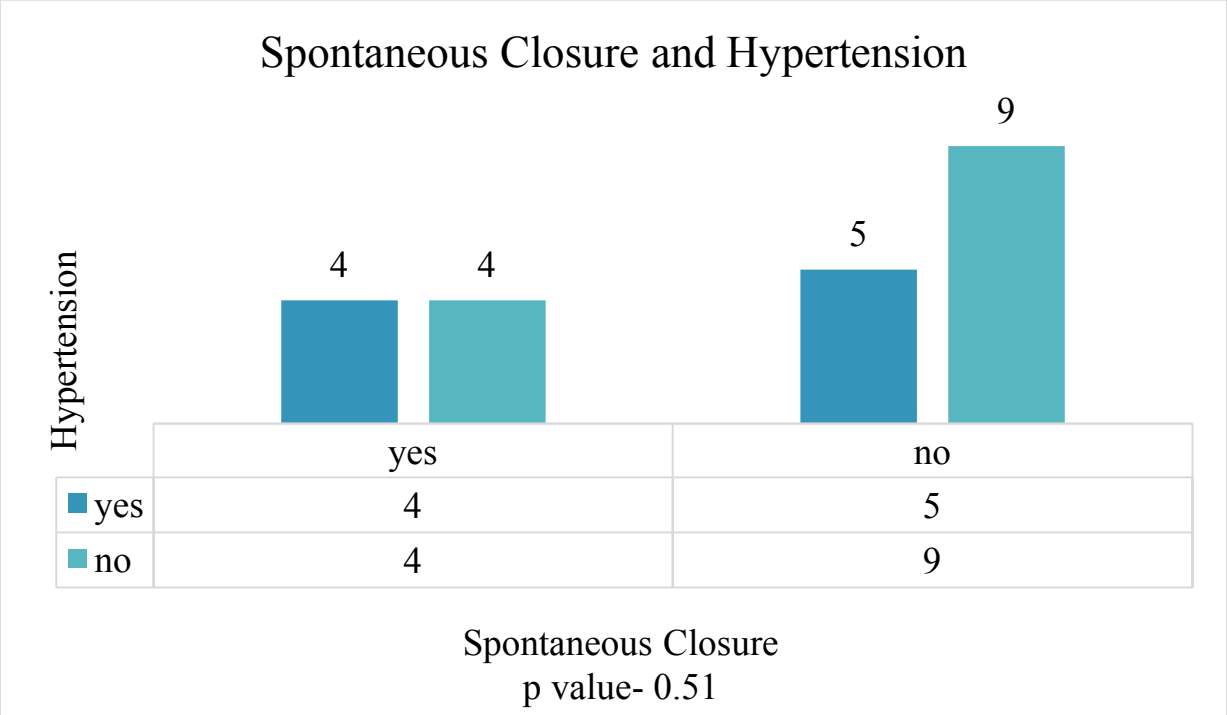
Comparing the presence of distal obstruction to the rates of spontaneous closure we get the following data with a p value of 0.34. None of the two cases with distal obstruction had spontaneous closure of the fistula.



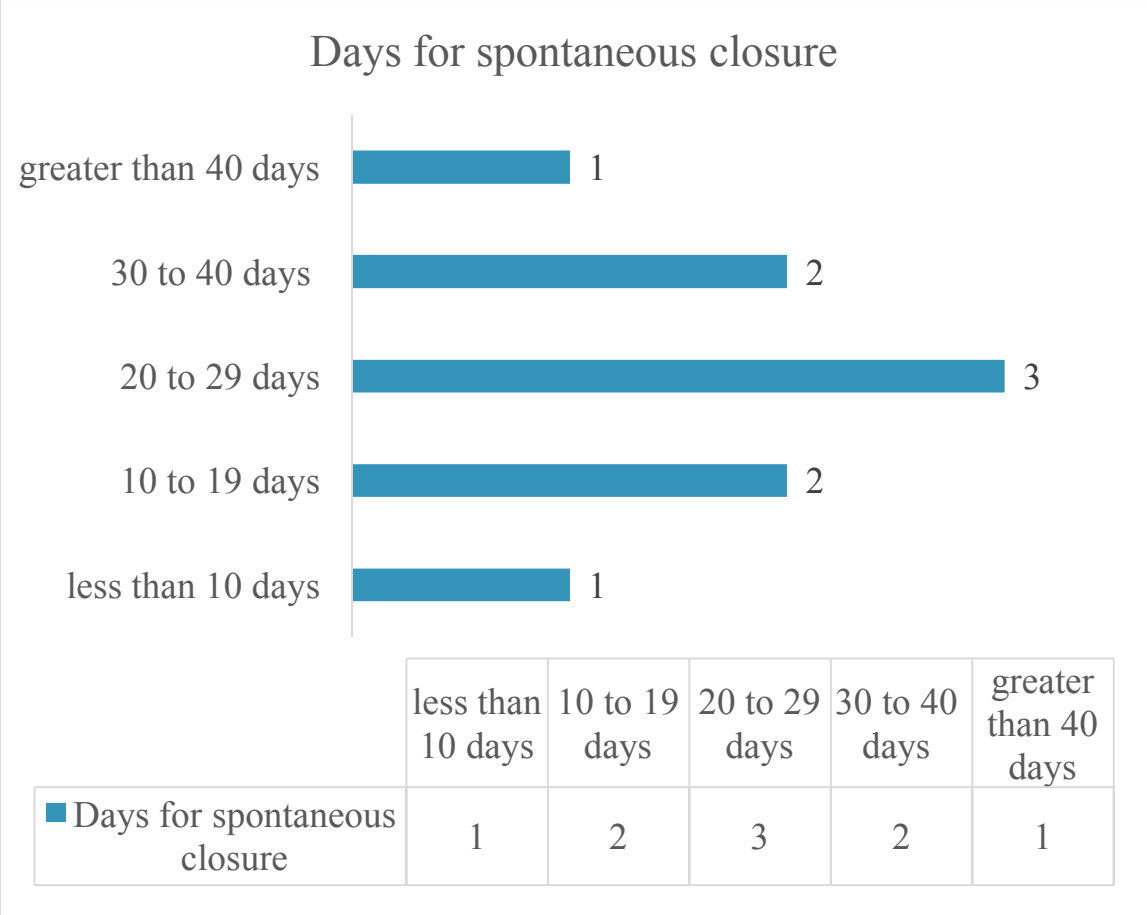
Comparing the rate of spontaneous closure with diabetes we get the following values with a p value or 0.60 which is not significant.



Comparing the Rate of spontaneous closure with hypertension we get the following values with a p value of 0.51.

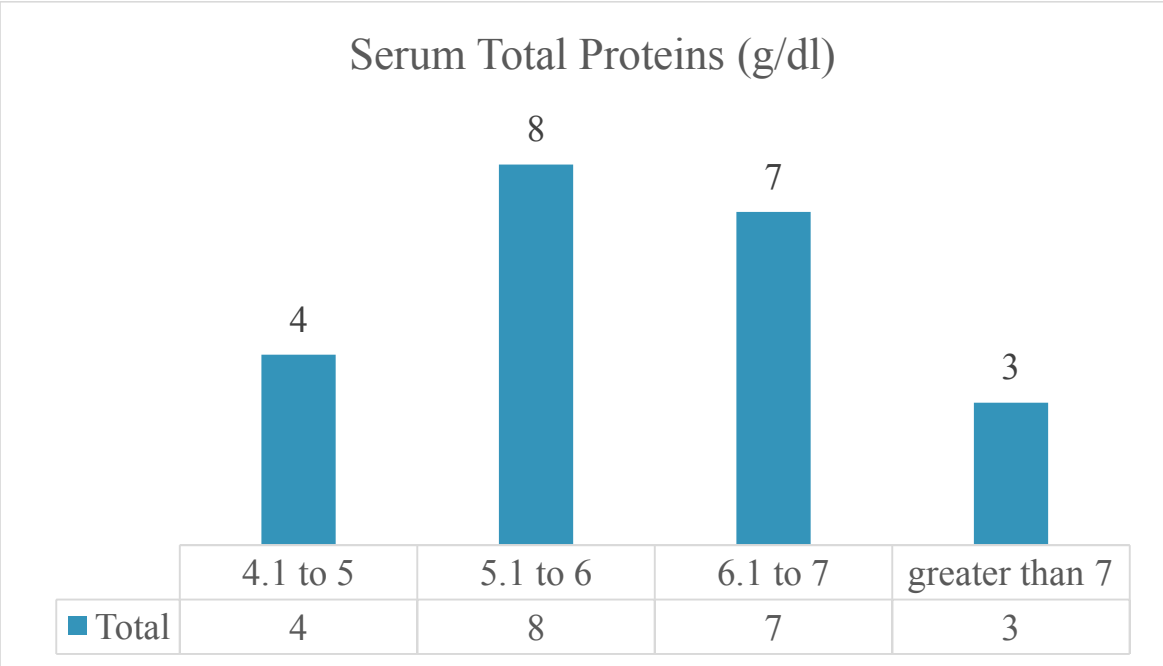


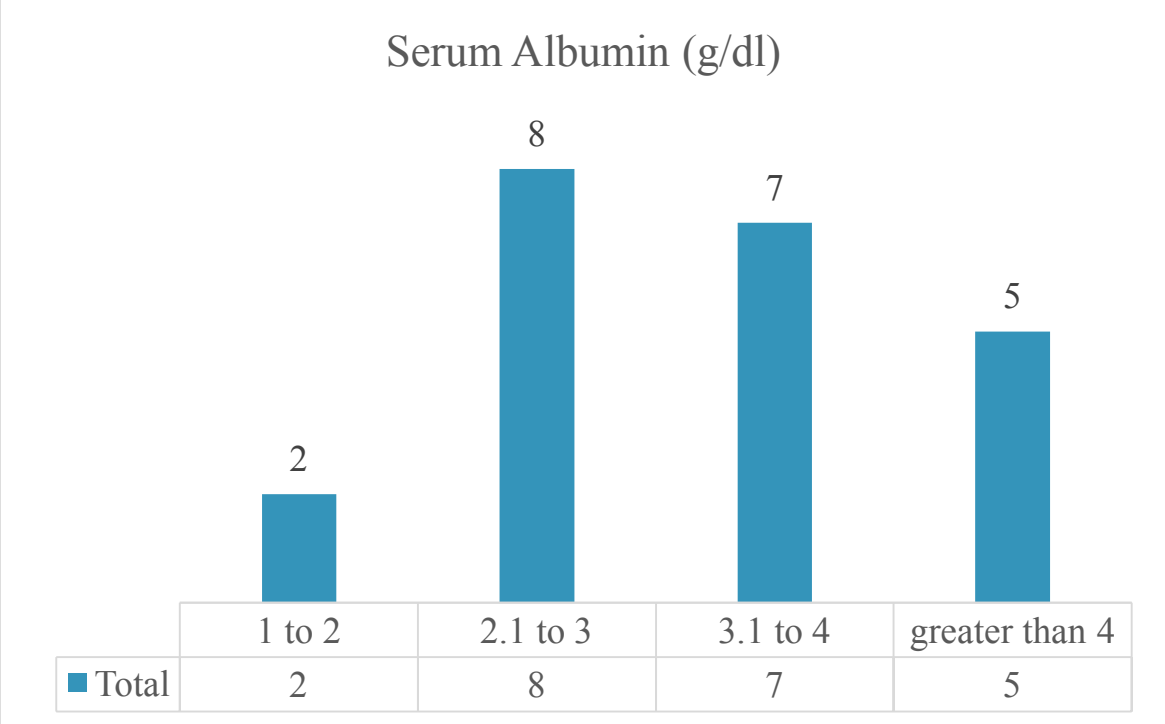
The mean duration of number of days of closure is 21.7 days. One case had closure of the fistula in less than 10 days, 2 cases between 10 to 19 days, 3 cases between 20 to 29 days, 2 cases between 30 to 40 days and 1 case greater than 40 days.



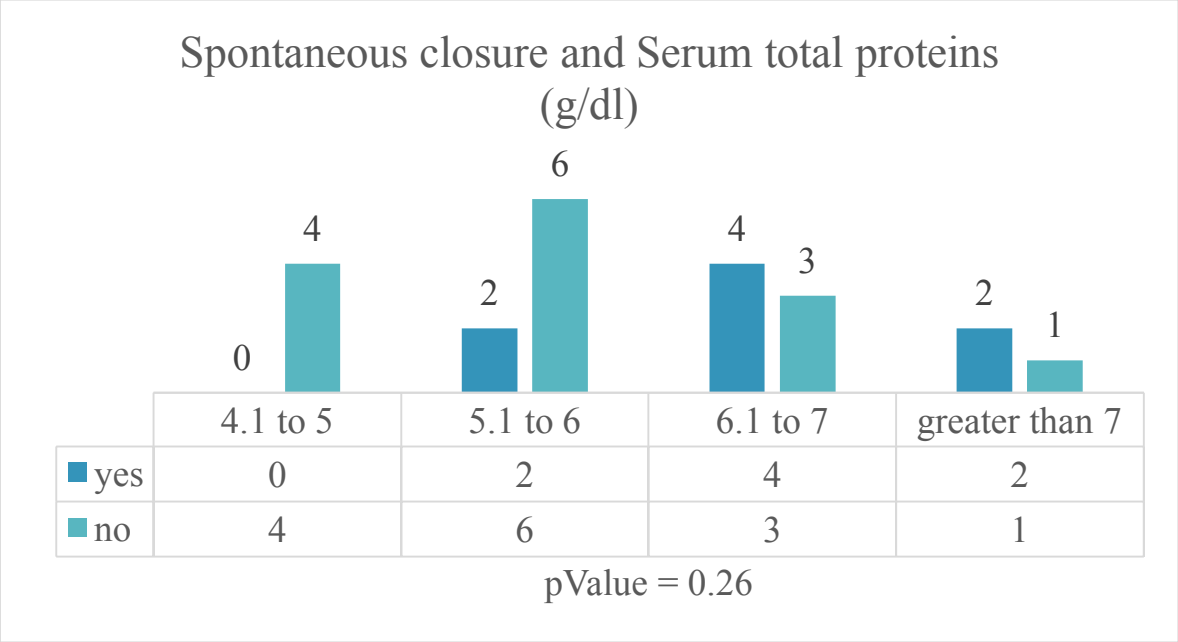
	less than 10 days	10 to 19 days	20 to 29 days	30 to 40 days	greater than 40 days
Days for spontaneous closure	1	2	3	2	1

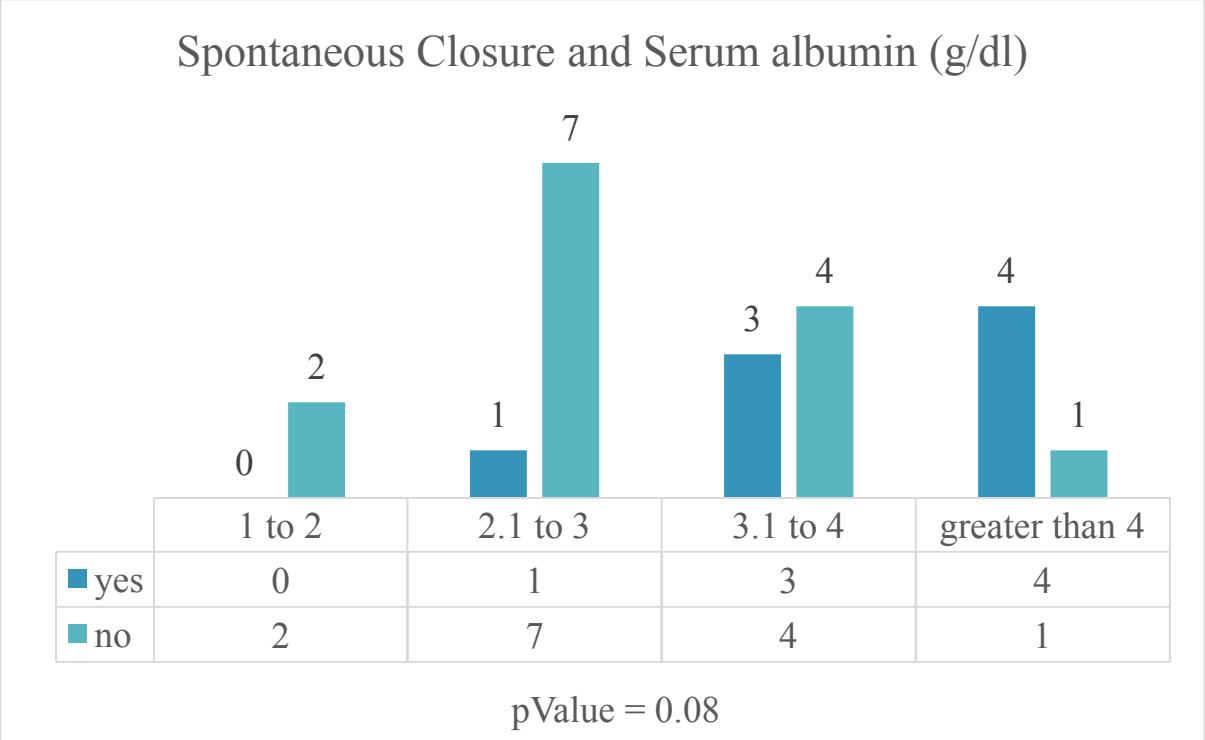
The serum total proteins and the serum albumin levels of the patients were divided into categories and their distribution is as follows.



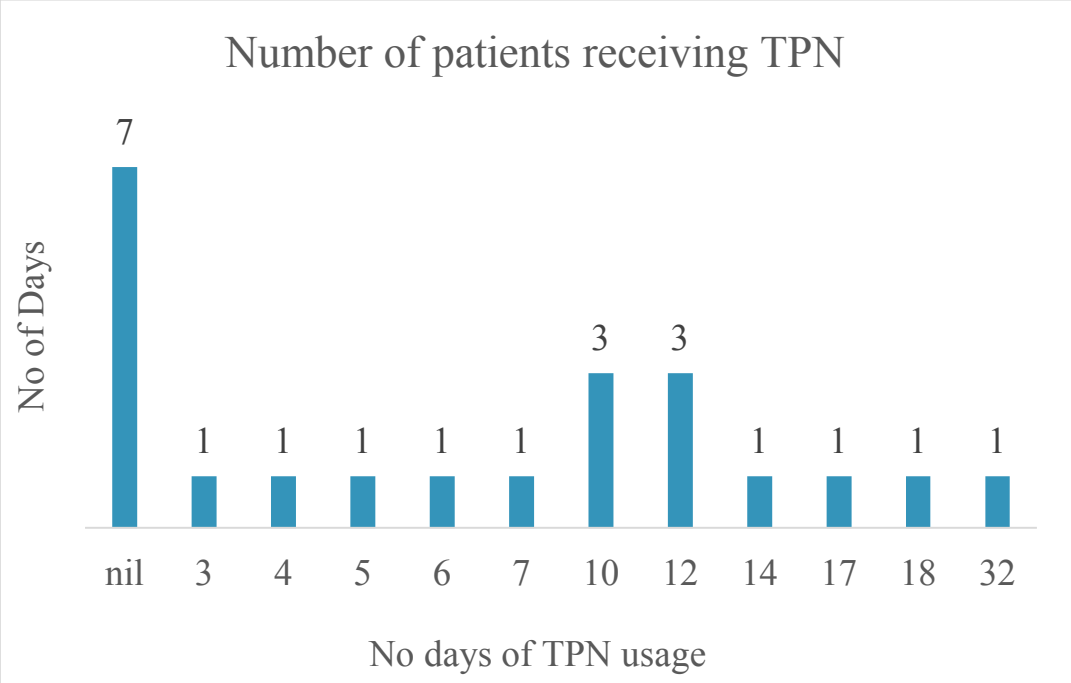


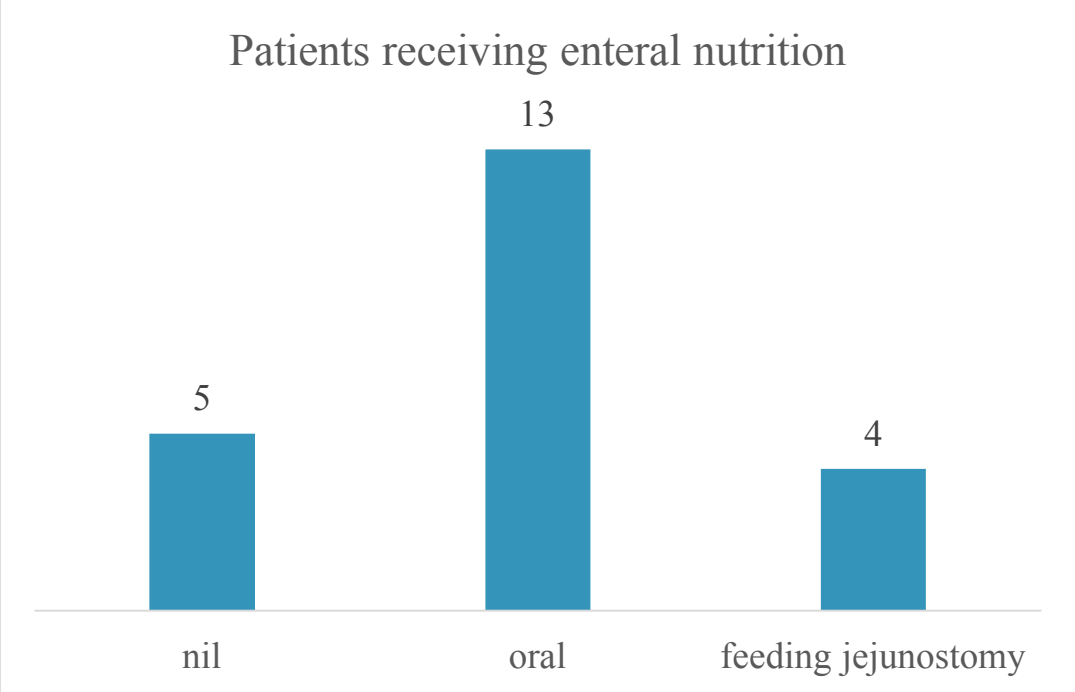
The comparison of serum total proteins and rates of spontaneous closure showed no significance statistically with a p value of 0.26 whereas comparison of serum albumin levels and the rates of spontaneous closure showed a p value of 0.08.





Of the 22 patients, 8 patients had surgical closure of the fistula. The mean time interval between the fistula onset and the time of surgery is 35 days. During this time 15 patients received Total parenteral nutrition and 17 patients received enteral nutrition either by oral or through a feeding jejunostomy.





There was no statistical significance of total parenteral nutrition usage and decrease in fistula output. (p value = 0.21).

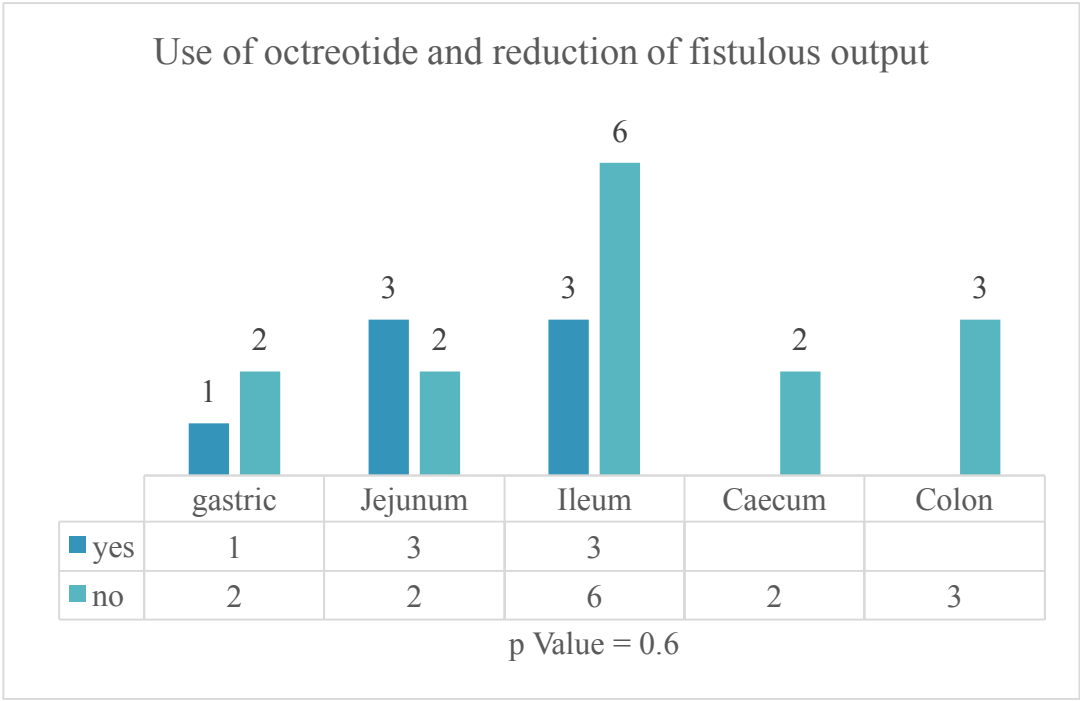
Reduction of fistula output	**Total parenteral nutrition received**	
	Yes	No
Yes	15	6
No	0	1
Grand Total	15	7

Comparing enteral nutrition and spontaneous closure yielded no significant results statistically. (p value = 0.22)

Enteral nutrition	**Spontaneous Closure**	
	Yes	No
Nil		5
Oral	7	6
Feeding jejunostomy	1	3
Grand total	8	14

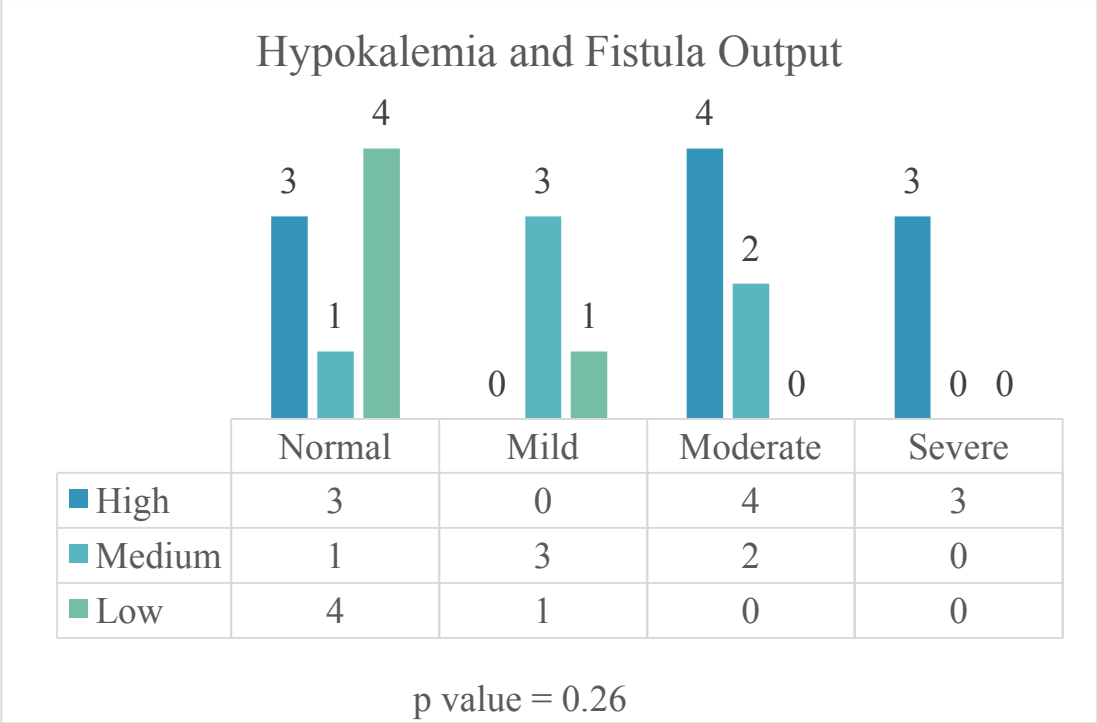
All patients received Injection Octreotide 100 µg subcutaneously every 8th hourly. It was continued fir 14 days if the fistula output is reducing but it was stopped after 5 days if there is no reduction in the fistula output.

Comparing the site of the fistula to the reduction of the fistula output we could see that those that responded to octreotide are usually gastric and small intestinal fistulas whereas the caecal and colonic fistulas showed no immediate reduction of output even using for 5 days. Though this result is not statistically significant. (P value of 0.6)

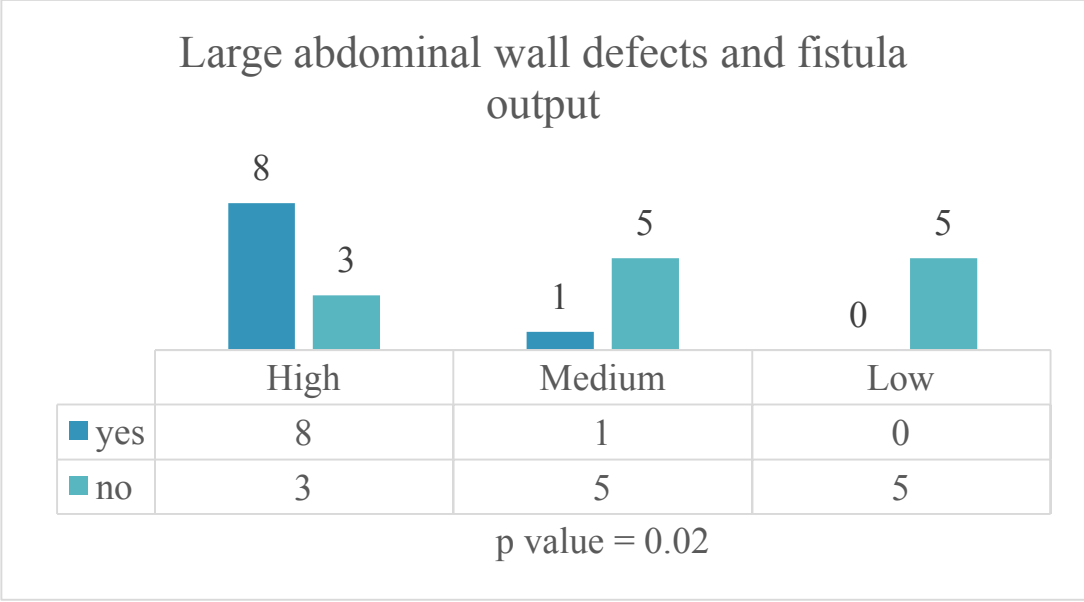


In this study 5 patients had hyponatremia with a serum Sodium level of less than 130 meq/l and 14 patients had hypokalemia. Of those patients 3 had sever hypokalemia with serum potassium levels less than 2.5 meq/l while 6 patients had moderate hypokalemia (serum potassium 2.5 to 3 meq/l) and 4 patients had mild hypokalemia (serum potassium levels 3 to 3.5meq/l). One patient had hyperkalaemia which was probably due to coexistent severe acute renal failure. Comparing the prevalence of hypokalemia and fistula output we could see that no patients with low output fistulas had moderate or severe

hypokalemia (p value = 0.26) while patients while only 3 of the 10 patients with high output fistulas had no hypokalemia (p value = 0.31).



Of the total, 9 patients in this study had large defects in the abdominal wall surrounding the fistula. These large defects where significantly associated with high output fistulas (p value = 0.02)



The main complications noted in this study were anemia, sepsis, electrolyte imbalances, renal failure, weight loss, skin excoriation and liver failure.

The table below lists the complications according to the output of the fistulas.

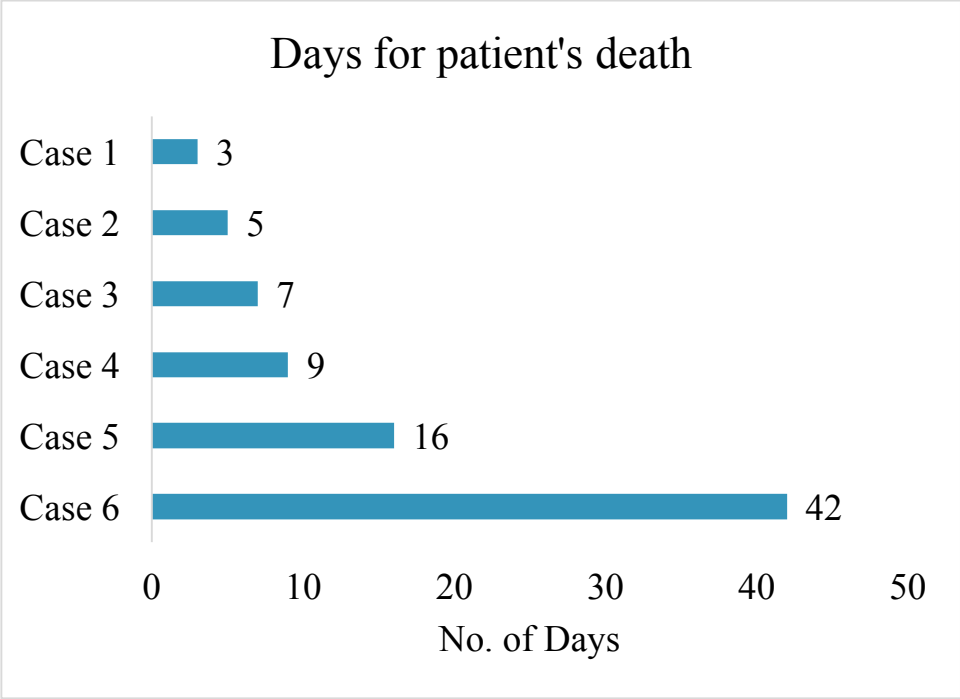
Fistula Output	renal Failure	Liver Failure	Sepsis	Hyponatre-mia	Hypokalem-ia	Anemia	Weight Loss	Mortality
High	11	7	11	4	8	5	7	4
Medium	3	2	6	1	6	2	4	2
Low	2	0	3	0	1	1	3	0
Total	16	**9**	**20**	**5**	**15**	8	**14**	**6**

18 of the 22 patients had skin excoriations due to fistula effluent irritating the skin around the fistula.

The average hospital stay of the patients is 32.45 days with a standard deviation of 17.88.

6 of the 22 (27.27%) patients died in the study and of which 4 (18.18%) had high output fistulas and 2 (9.09%) had medium output fistulas. They were no mortality recorded in patients with low output fistulas (p value=0.5).

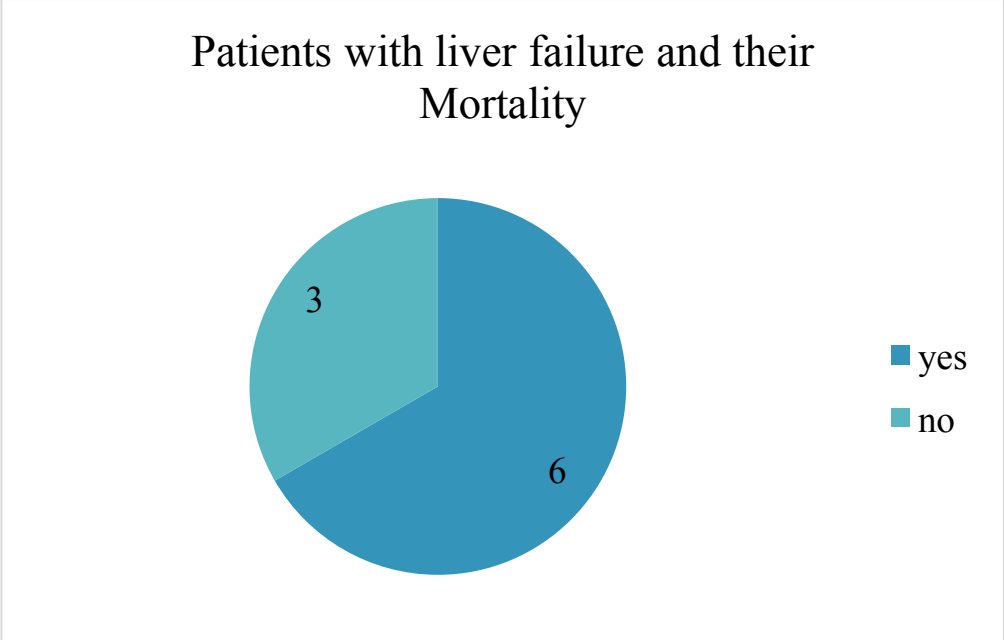
4 of the 6 mortalities occurred within the first 10 days of developing a fistula. One patient died in the 16th day and one other patient died in the 42nd day



2 out of 5 patients with jejunal fistulas and 4 out of 9 patients with ileal fistulas died in this study.

The relationship between renal failure and mortality is not statistically significant with a p value of 0.22. Where as the presence of liver failure is

statistically significant indicator of mortality with a p value of 0.03. All patients who died had presence of liver failure before their death.



Discussion

Enterocutaneous fistula provides a great challenge to the surgeon. It needs a holistic approach in management with combined medical, surgical and intensive care unit teams. In this study of 22 patients who developed post-surgical fistula the mean age of the patients was 55 with a standard deviation of 10 years.

Majority of the patients were within 50 to 70 years of age. The most common cause of the fistula was due to anastomotic leak, followed by hollow viscous perforation, post appendicectomy and then inadvertent enterotomy. In a large case series done by Rose et al (8) with 114 cases the most common cause was due to “surgical misadventure” accounting for about 76% of the postoperative fistulas. In this study anastomotic leak accounts for 69% of the cases while there was only one case of inadvertent enterotomy.

Majority of the cases in this study (91%) are done in an emergency setting either due to acute intestinal obstruction or hollow viscous perforation are in acute gangrenous appendicitis. Only in 2 of the 22 patients elective surgery was done. One patient developed a leak after a right hemicolectomy done for ascending colon malignancy for which ileo-transverse anastomosis was done and she developed a leak which resolved spontaneously. The other patient had a transverse loop colostomy done for sigmoid colon anastomosis for sigmoid volvulus. The loop colostomy was closed extra peritoneally which developed a leak and it settled spontaneously.

The patients with emergency surgery done usually has increased risk for formation of fistulas because they usually present with sepsis, with compromised hemodynamics, renal and/or liver functions. In this setting they are also the patients who are usually poorly nourished hailing from a low socioeconomic class. This is similar to a study by Kumar S et al (42) which showed 11% of the surgeries done in an emergency setting developed fistula whereas, no one developed fistula following an elective surgery.

Ileum was the most common site for formation of enterocutaneous fistula accounting for 41% of the cases, followed by jejunum, stomach, colon and caecum. Ileal fistulas were almost due to anastomotic leak. Gastric fistulas were all due to large gastric perforations for which omental patch closure was done. The patients then developed fistula. One of the gastric fistulas closed spontaneously whereas the other two required surgical correction.

Jejunal fistulas never had spontaneous closure. Feeding was given through a feeding jejunostomy tube distal to the fistula. The biliary and pancreatic juices from the fistula were refed into the feeding jejunostomy. This prevented the patients from developing or worsening of electrolyte abnormalities

Though spontaneous closure was not significantly associated with the site of the fistula it was significantly associated with the output of the fistula. There is no rationale in waiting for a high output fistula to spontaneously close whereas a low output fistula can be managed expectantly for spontaneous closure to occur.

Medium output fistulas on the other hand have varying results. Other factors like length of the tract, presence of distal obstruction and nutritional status of the patient comes into play. Though no statistical significance was achieved in this study for presence of distal obstruction and spontaneous closure of the fistula it is documented in a lot of studies as already reviewed earlier. This may be because only 2 patients had distal obstruction in our study and in both of these patients no spontaneous closure occurred.

The mean duration of spontaneous closure in this study was 21.7 days with a standard deviation of 10.4 days. The longest to spontaneously close was 40 days which was a colonic fistula, the shortest was within 9 days for a caecal fistula which developed post appendicectomy for a gangrenous appendix.

The presence of coexisting diabetes mellitus or systemic hypertension had no contributions in the spontaneous closure of a fistula a seen in this study.

Almost all patients in this study were under nourished, only 3 patients had a serum total protein of 7 g/dl or higher, while 12 patients had protein level of 6 g/dl or lower. Comparing these with the rates of spontaneous closure yielded no statistical significance. 2 patients in this study had severe hypoalbuminemia and 15 patients had mild to moderate hypoalbuminemia. This may be explained by the catabolic state of the patient due to ongoing loss peptide rich fluids to the outside through the fistula. All patients with hypoalbuminemia have very low blood oncotic pressure which may lead to extravasation of fluid and its collection

in third spaces this may lead to worsening of hemodynamics of the patient and may also lead to underestimate the fluid correction needed. Hypoalbuminemia was associated with spontaneous closure with a p value of 0.08. this shows that estimation of serum albumin levels rather than total proteins may lead to a little more accurate estimation of the patient's nutritional status.

4 out of the 6 mortalities were within the first 10 days of fistula formation. This is the critical period in which the patient is in sepsis and has several metabolic and electrolyte abnormalities. Hypokalemia was the most common electrolyte abnormality observed in this study. This is more profound in proximal high output fistulas. Only one patient with a low output fistula developed hypokalemia. Other electrolyte abnormalities include hyponatremia and hypocalcaemia.

The patients were invariably in sepsis, though, majority of them were in sepsis even pre-operatively. The common microorganisms isolated from the culture of the fistula output were coliforms like E. coli and Klebsiella species. Though no enterococci were isolated in this study this may further complicate because of resistances to majority of the higher antibiotics.

Nutrition is another key aspect in the management of enterocutaneous fistulas. From the advent of total parenteral nutrition there is a marked decrease in the mortality of the patient. In this study however, we were limited by the availability of total parenteral nutrition. The patients received TPN

as long as it was available. We found no significant association between using TPN and spontaneous closure of the fistula.

Enteral nutrition must always be preferred over parenteral nutrition as it improves the gut flora and reduces the electrolyte abnormalities (43). Enteral nutrition may be provided through a feeding enterostomy tube distal to the fistula. Many times, it is not possible to do so. The concept of keeping a patient nil per oral and giving the 'bowel rest' is becoming obsolete. (43). Enteral nutrition protects the gut mucosa. Also, there is refeeding of the fistulous output into a mucous fistula or an enterostomy tube. Though this may be unacceptable by many patients, this enable a good method to continue enteral nutrition.

Octreotide, a somatostatin analogue is used to reduce the fistulous output by decreasing biliary, pancreatic and intestinal secretions. In this study it was found to be useful in fistulas arising from the stomach and small intestine only. No reduction of the output was observed for fistulas arising from the large bowel or caecum. Though there is no statistical significance in this study it may be used in regular management of these patients.

Figure 2: Re-feeding of the fistulous content into the distal segment

Other complications that arise commonly include anemia, weight loss, skin excoriations, intra-abdominal abscesses, and presence of a large defect in the abdominal wall. The presence of inflammation of the skin and subcutaneous

tissue causes a problem while closing the abdomen after surgery. Skin excoriations must be vigorously treated with soothing creams and lotions and avoiding the pouring of the effluent onto the skin using isolated stoma bags or VAC dressings should be done.

Figure 3: Severe skin excoriation around the fistula

The mortality associated with this study is 27.2%. 66% of the deaths occurred within the first ten days of developing the fistula. This is a critical period in which the patient is prone to develop sepsis and electrolyte abnormalities. The mortality is more with high output fistulas. Low output fistulas tend not to produce severe electrolyte imbalances and sepsis.

16 patients developed renal failure during the course of the disease. This is probably due dehydration, impaired renal perfusion and sepsis. The development of renal failure is not significantly associated with mortality. However, 9 patients developed Liver failure noted by elevation of SGOT and SGPT enzymes. This occurred as a consequence of severe disseminated septicaemia with multi-organ dysfunction. No patient who received TPN had elevated liver parameters in this study. Liver failure due to MODS is a good predictor of mortality with a p value of 0.03

Blood Transfusions were given to 14 of the 22 patients the need for blood transfusions was not only decided by the haemoglobin and the hematocrit but also the hemodynamic status of the patients.

The mean hospital stay of the patient is 32 days. This causes significant distress to the patients and their families. The longest stay was for 65 days. The patient also has the stigma of feculent smell and discharge. This also causes significant psychological stress to the patient. Adequate and proper counselling must be given to the patients and their relative to overcome this.

Though mortality of enterocutaneous fistula is high, aggressive management of the patient in the initial 2 weeks of the treatment and prevention of excessive excoriation of the abdominal wall and control of sepsis, and providing adequate nutrition can give good results and can cure the patient.

Conclusion

Enteric fistulas, occurring spontaneously or in the postsurgical period, represent a significant management challenge and may result in both morbidity and occasionally mortality for the patient. The care in these patients may be complex and has led to the establishment of specialized intestinal failure units, aimed at optimizing outcome.

This study is restricted only to postoperative fistulas. Spontaneous fistulas occurring due to an underlying bowel pathology is not discussed and studied. Also, there are not several randomised control studies for proper nutrition and use of pharmacological agents and varying techniques for surgery.

Use of vacuum assisted dressings or stoma wound management appliances for management of fistula was not feasible in this study. Their optimum usage may further improve the outcome of the disease.

Also, the key to surgical resection od the fistula and restoring bowel continuity is the timing of the surgery. Early surgical intervention in a hemodynamically unstable patient leads to increased mortality. Properly staged definitive procedure after correcting the sepsis and improving the nutrition of the patient leads to the best results.

Although parenteral nutrition and bowel rest may be often advocated, enteral nutrition must be initiated as soon as possible with supplement of

parenteral nutrition. There is no adequate number of randomised trials for purely parenteral vs enteral nutrition. There is no evidence to suggest that parenteral nutrition alone and giving ‘bowel rest’ is beneficial for the patient.

General principles of care must include

(1) early recognition and stabilization of patients with fistulas combined with control of sepsis and provision of nutritional support;

(2) investigation of the anatomic and etiological characteristics of each fistula, thus providing information about the likelihood of spontaneous closure or need for operative management;

(3) decision making regarding the approach to management, including the involvement of a multidisciplinary team, will provide the best possibility of resolution of the fistula;

(4) definitive surgical therapy in a controlled setting; and

(5) postoperative care including physical rehabilitation and emotional support, which together help the patient return to their premorbid condition.

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CONSENT FORM

I , do hereby volunteer and consent to participate in this study being conducted by DR. Prashanth S on “A STUDY ON CAUSES AND MANAGEMENT OF ENTEROCUTANEOUS FISTULA ". I have read and understood the consent form or it has been read and explained to me in my own language. The study has been fully explained to me and I may ask questions at any time.

Signature / Left Thumb Impression of the Volunteer

Date:

Place: Signature and Name of witness

Signature of the investigator

Sl. No.	name	age	sex	cause	exact cause	operated in this institution	emergency/ elective	site
1	esswaran	54	m	mesentric ischemia post ileoileal anastamosis	Anastamotic leak	yes	emergency	Ileum
2	ramathal	67	f	mesentric ischemia post ileoileal anastamosis	Anastamotic leak	yes	emergency	Ileum
3	bagyam	65	f	hemicolectomy with ileo transverse anastamosis, ca colon	Anastamotic leak	yes	elective	Colon
4	murugan	48	m	feeding jejunostomy, inadvertant enterotomy	Inadvertant enterotomy	yes	emergency	Jejunum
5	sudharsan	55	m	antral perforation	Hollow viscous perforation	yes	emergency	gastric
6	murugathal	46	f	ileal perforation penetration trauma, resection and anastamosis done	Anastamotic leak	yes	emergency	Ileum
7	saraswathy	51	f	iatorogenic rectal perforation, colostomy done, colostomy closure leak	Anastamotic leak	yes	emergency	Colon
8	nagarajan	62	m	antral perforation	Hollow viscous perforation	yes	emergency	gastric
9	mary	48	f	appendicular perforation, caecal fistula	Post appendicectomy	yes	emergency	Caecum
10	palaniappan	56	m	ileocecal tuberculosis, ileo-transverse anastamosis	Anastamotic leak	yes	emergency	Ileum
11	rajasundaram	72	m	ileal gangrene, ileo-ileal anastamosis	Anastamotic leak	yes	emergency	Ileum
12	selvi	29	f	corrosive acid poisoning, jejunal perforation	Hollow viscous perforation	no	emergency	Jejunum
13	vadivelu	65	m	mesentric ishemia, jejuno ileal anastamosis	Anastamotic leak	yes	emergency	Jejunum
14	shanmugam	58	m	ileocecal tuberculosis, ileo-transverse anastamosis	Anastamotic leak	yes	emergency	Ileum
15	kumaran	48	m	mesentric ischemia, jejuno ileal anastamosis	Anastamotic leak	no	emergency	Jejunum
16	dilip	35	m	penetrating injury, ileo-ileal anastamosis	Anastamotic leak	yes	emergency	Ileum
17	venmathi	64	f	ascending colon growth, ileo transverse anastamosis done	Anastamotic leak	yes	emergency	Ileum
18	narayanan	58	m	gangrenous appendix, post appendicectomy, caecal fistula	Post appendicectomy	yes	emergency	Caecum
19	muthuraman	65	m	ileal gangrene, ileo-ileal anastamosis	Anastamotic leak	yes	emergency	Ileum
20	sundaresan	48	m	antral perforation	Hollow viscous perforation	yes	emergency	gastric
21	lakshmanan	58	m	mesentric ischemai, post jejuoileal anastamosis	Anastamotic leak	no	emergency	Jejunum
22	amsaveni	67	f	colostomy closure leak	Anastamotic leak	yes	elective	Colon

hb	Anemia	blood transfusion	protiens	Protiens Range	albumin	albumin range	spontaneous closure	distal obstruction	days for closure	Days classification	Surgical closure
14	No	yes	6.2	6.1 to 7	3.2	3.1 to 4	no	no			no
7.8	Yes	yes	5.8	5.1 to 6	2.8	2.1 to 3	no	no			no
9.8	Yes	yes	6.4	6.1 to 7	3.5	3.1 to 4	yes	no	32	30 to 40 days	no
12	No	no	6.8	6.1 to 7	3.9	3.1 to 4	no	no			yes
15	No	no	5.5	5.1 to 6	3	2.1 to 3	no	no			yes
9	Yes	yes	5	4.1 to 5	2.8	2.1 to 3	no	no			yes
10	No	yes	5.2	5.1 to 6	2.4	2.1 to 3	yes	no	40, 20	greater than 40 days	no
13	No	no	6.4	6.1 to 7	4.1	greater than 4	yes	no	14	10 to 19 days	no
14	No	no	7.2	greater than 7	5.2	greater than 4	yes	no	20	20 to 29 days	no
8	Yes	yes	5.1	5.1 to 6	3.2	3.1 to 4	no	no			no
12	No	no	6.8	6.1 to 7	4.2	greater than 4	yes	no	36	30 to 40 days	no
9	Yes	yes	4.1	4.1 to 5	1.9	1 to 2	no	no			no
7.8	Yes	yes	5.1	5.1 to 6	2.8	2.1 to 3	no	no			yes
12.3	No	no	5.2	5.1 to 6	2.4	2.1 to 3	no	yes			no
9.2	Yes	yes	4.8	4.1 to 5	2.3	2.1 to 3	no	no			yes
12.3	No	yes	7.2	greater than 7	4.8	greater than 4	no	yes			yes
12.3	No	yes	4.8	4.1 to 5	1.9	1 to 2	no	no			yes
9.8	Yes	yes	6.8	6.1 to 7	4.2	greater than 4	yes	no	9	less than 10 days	no
14	No	no	7.5	greater than 7	3.8	3.1 to 4	yes	no	28	20 to 28 days	no
16	No	no	6.2	6.1 to 7	3.6	3.1 to 4	no	no			yes
12	No	yes	5.5	5.1 to 6	2.8	2.1 to 3	no	yes			no
10	No	yes	5.6	5.1 to 6	3.2	3.1 to 4	yes	no	13	10 to 19 days	no

Surgery done after (days)	Urea	creatinine	Sodium	Hyponatremia	Potassium	Hypokalemia	No. of days of TPN usage	Tpn Recived	Enteral nutrition	route
	40	1.2	140	No	2.8	Moderate	12	Yes	10	oral
	110	2.8	136	No	5.5	Normal	4	Yes	0	nil
	38	1	135	No	3.8	Normal	nil	No	24	oral
49	42	1.2	140	No	2.8	Normal	18	Yes	35	ding jejunosto
28	66	2	126	Yes	2.8	Moderate	nil	No	18	ding jejunosto
32	129	2.5	127	Yes	2.6	Normal	NIL	No	27	oral
	43	1.2	145	No	4.2	Normal	10	Yes	22	oral
	132	2.9	136	No	2.4	Severe	3	Yes	12	ding jejunosto
	42	1	145	No	3.2	Mild	nil	No	13	oral
	92	1.8	136	No	5.4	Normal	5	Yes	nil	nil
	47	1.4	142	No	3	Moderate	12	Yes	19,oral	oral
	165	4.5	152	No	5.6	yperkalem	nil	No	nil	nil
38	96	2.2	143	No	2.3	Severe	32	Yes	25	oral
	96	2.4	126	No	3.2	Mild	14	Yes	nil	nil
34	127	2.3	124	No	2.8	Moderate	17	Yes	28	oral
39	48	1.3	143	No	3.4	Moderate	10	Yes	38	oral
30	79	1.9	128	Yes	3.1	Mild	12	Yes	35	oral
	28	0.9	142	No	4.2	Normal	nil	No	7	oral
	118	2.9	152	No	3.3	Mild	10	Yes	20	oral
30	56	1.5	128	Yes	2.8	Moderate	6	Yes	6	ding jejunosto
	106	3.2	124	Yes	2.2	Severe	7	Yes	nil	nil
	32	1	143	No	3.9	Normal	nil	No	8	oral

Fistula Output	Class	Final Output	Fistula Output Decreased	Fistula recurrence	Octreotide reduces output	days of octrotide	Hospital stay	Mortality	renal filure	liver failure
1000	High	250	yes	nil	no	14	42	yes	yes	yes
550	High	300	yes	no	no	5	5	yes	yes	yes
60	Low	NIL	yes	no	no	5	35	no	yes	no
1500	High	400	yes	no	no	14	65	no	yes	yes
1500	High	400	yes	no	yes	14	35	no	yes	no
700	High	100	yes	no	yes	14	40	no	yes	no
70	Low	nil	yes	yes	no	5	65	no	no	no
1200	High	nil	yes	no	no	5	28	no	yes	no
250	Medium	nil	yes	no	no	5	28	no	no	no
350	Medium	350	yes	no	no	5	7	yes	yes	yes
250	Medium	nil	yes	no	yes	14	47	no	no	no
1750	High	1750	no	no	no	3	3	yes	yes	yes
1250	High	700	yes	no	yes	14	46	no	yes	yes
400	Medium	350	yes	no	no	5	16	yes	yes	yes
1200	High	600	yes	no	yes	14	44	no	yes	no
350	Medium	150	yes	no	no	5	49	no	no	no
250	Medium	150	yes	no	no	5	40	no	yes	no
100	Low	nil	yes	no	no	5	15	no	no	no
180	Low	nil	yes	no	yes	14	36	no	yes	no
1300	High	600	yes	no	no	5	37	no	yes	yes
1400	High	350	yes	no	yes	8	9	yes	yes	yes
150	Low	nil	yes	no	no	5	22	no	no	no

sepsis	weight loss	time for death	Diabetes	Hypertension	large defect	Skin excoriation
yes	yes	22	no	no	yes	yes
yes	no	5	yes	no	yes	yes
no	yes	na	yes	yes	no	no
yes	yes	na	no	no	yes	yes
yes	yes	na	no	yes	no	yes
yes	yes	na	yes	no	yes	yes
yes	yes	na	yes	no	no	no
yes	yes	na	no	yes	yes	yes
yes	yes	na	no	no	no	no
yes	no	7	yes	yes	no	yes
yes	yes	na	yes	yes	no	yes
yes	no	5	no	no	no	yes
yes	yes	na	no	yes	yes	yes
yes	yes	16	no	no	yes	yes
yes	no	na	no	yes	yes	yes
yes	no	na	no	no	no	yes
yes	yes	na	yes	no	no	yes
yes	no	na	no	yes	no	yes
yes	yes	na	no	no	no	yes
yes	yes	na	yes	yes	yes	yes
yes	no	9	no	no	no	yes
no	no	na	yes	no	no	no